

Prepared for:
International Paper
Franklin, Virginia



Source-Specific BART Exemption Modeling Report: International Paper – Franklin, VA

ENSR Corporation
October 2006
Document No.: 06890-435-101

Prepared for:
International Paper
Franklin, Virginia



Source-Specific BART Exemption Modeling Report: International Paper – Franklin, VA



Prepared by: Jeffrey Connors



Reviewed by: Robert Iwanchuk

ENSR Corporation
October 2006
Document No.: 06890-435-101

Contents

1.0 Introduction.....	1-1
1.1 Objectives	1-1
1.2 Location of Source vs. Relevant Class I Areas	1-1
1.3 Organization of Document	1-2
2.0 Source Description and Emissions Data.....	2-1
3.0 Input Data to the CALPUFF Model.....	3-1
3.1 General Modeling Procedures	3-1
3.2 Air Quality Database (Background Ozone and Ammonia)	3-1
3.3 Natural Conditions and Monthly f(RH) at Class I Areas.....	3-1
4.0 Air Quality Modeling Procedures.....	4-1
4.1 Model Selection and Features	4-1
4.2 Modeling Domain and Receptors	4-1
4.3 Technical Options Used in the Modeling.....	4-1
4.4 Light Extinction and Haze Impact Calculations	4-1
5.0 BART Exemption Modeling Results	5-1
Appendix A Source-Specific Emissions Data for BART Baseline Case	A-1
Appendix B NCASI Particulate Emissions Data for Pulp and Paper Industry Specific Sources.....	B-1
Appendix C New IMPROVE Formula Implementation Procedure.....	C-1
Appendix D CALPOST Files: James River Face, Shenandoah, and Swanquarter.....	D-1

List of Tables

Table 2-1	IP Franklin – Baseline BART Stack Parameters and Criteria Pollutant Emissions.....	2-3
Table 2-2	IP Franklin – Baseline BART Particulate Speciation.....	2-4
Table 4-1	Annual Average Background and Monthly f(RH) used in CALPOST	4-2
Table 5-1	Summary of Results – IP Franklin Refined BART Exemption Modeling.....	5-1

List of Figures

Figure 1-1	Location of Class I Areas in Relation to IP Franklin Mill.....	1-3
Figure 3-1	Extent of Computational Grid	3-3

1.0 Introduction

1.1 Objectives

The Regional Haze Rule regulations require Best Available Retrofit Technology (BART) for any BART-eligible source that “emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility” in any mandatory Class I federal area. Pursuant to federal regulations, states have the option of exempting a BART-eligible source from the BART requirements based on site-specific dispersion modeling demonstrating that the source cannot reasonably be anticipated to cause or contribute to visibility impairment in a Class I area. As a member state of the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) regional planning organization, Virginia DEQ is accepting site-specific BART exemption modeling demonstrations that follows VISTAS guidance.

The International Paper Franklin Mill (IP Franklin) has been identified as a BART-eligible source. As noted above, a dispersion modeling demonstration can be used to show that a source identified as being eligible for BART requirements can be exempt if modeling shows the source does not cause or contribute to a visibility impairment as defined by the BART guideline (40 CFR Part 51, Appendix Y). As such, IP Franklin has prepared this report in order to summarize the process by which dispersion modeling was conducted to show that impacts from the BART eligible units at the facility do not cause or contribute to an impairment of visibility, according to the BART rule.

A list of the BART eligible units at IP’s Franklin Mill that are included in the exemption modeling can be found below.

- No. 7 Power Boiler (7PB)
- Nos. 4, 5 and 6 Recovery Boilers (4RB, 5RB and 6RB)
- Nos. 4, 5 and 6 Smelt Dissolving Tanks (4SDT, 5SDT and 6SDT)
- Nos. 3 and 4 Lime Kilns (3LK and 4LK)
- Nos. 5 and 6 Lime Slaker (5LS and 6LS)
- Nos. 1, 2 and 3 Dry End Starch Silos (1SS, 2SS, and 3SS)
- Batch Digester Operation
- K1 Digester
- K2 Digester
- D, E and F Evaporator Sets

IP Franklin’s BART exemption modeling was conducted using the detailed procedures outlined in the final common BART modeling protocol developed by VISTAS dated August 31, 2006. A site-specific modeling protocol was submitted to Virginia DEQ on April 13, 2006. In addition to summarizing the results of the exemption modeling that has been conducted, this report addresses the comments received from DEQ in their letter dated July 10, 2006 approving the site-specific modeling protocol.

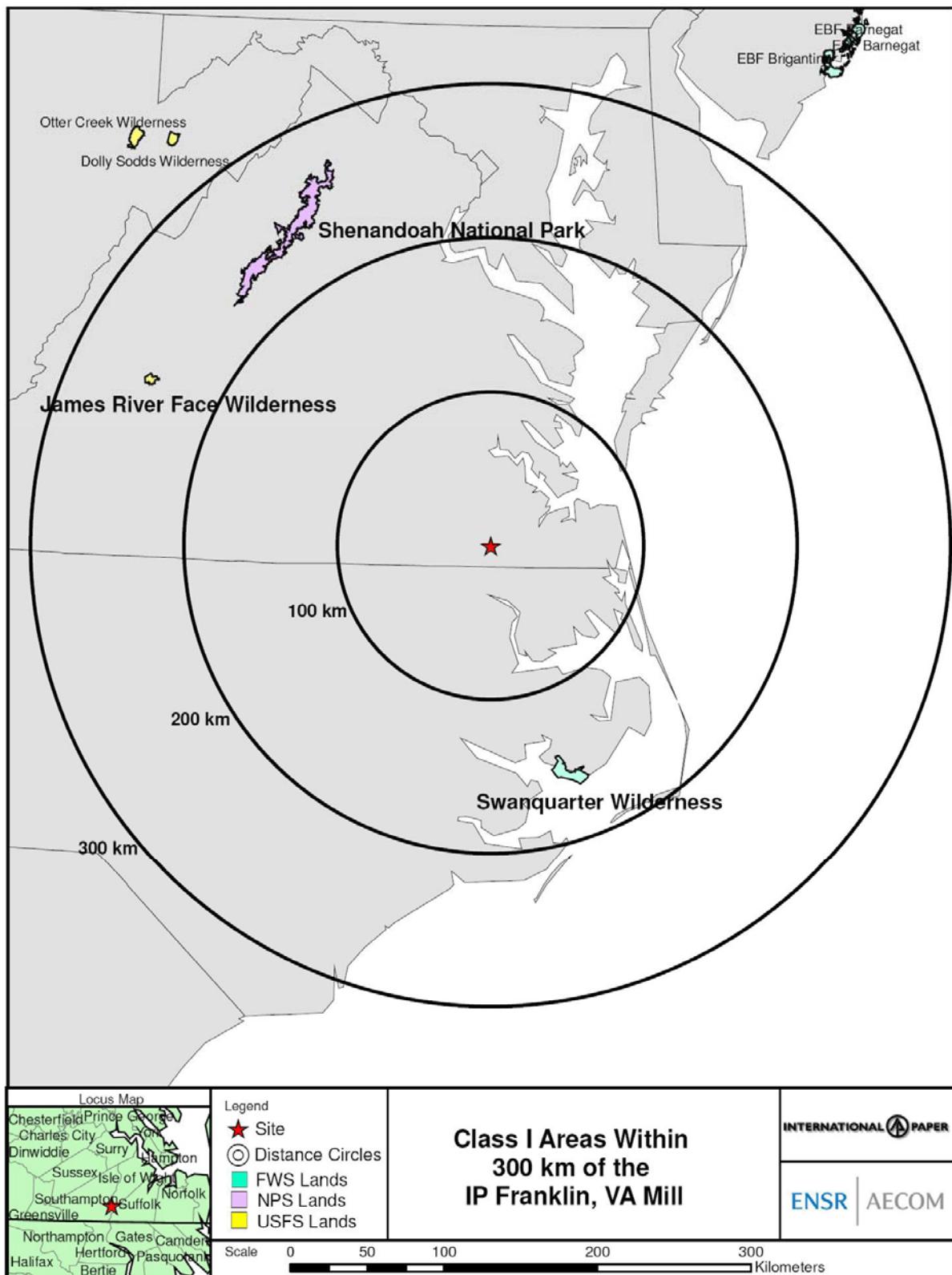
1.2 Location of Source vs. Relevant Class I Areas

Figure 1-1 shows a plot of the IP Franklin Mill relative to nearby Class I Areas. There are three Class I areas within 300 km of the mill: Swanquarter Wilderness Area (managed by the Fish and Wildlife Service), James River Face Wilderness Area (managed by the US Forest Service), and Shenandoah National Park (managed by the National Park Service).

1.3 Organization of Document

Section 2 of this report describes the emission rates from the BART-eligible units that were used as input to the BART exemption modeling. Section 3 describes other input data used for the exemption modeling including the modeling domain, terrain and land use, and meteorological data. Section 4 describes the air quality modeling procedures and Section 5 discusses the exemption modeling results. Since all of the references cited are also included in the VISTAS common BART modeling protocol, no additional references section has been provided for this report. Appendix A provides additional background information on the baseline unit emission rates. Information on particle speciation for pulp and paper source categories is presented in Appendix B. Appendix C includes a discussion of the implementation of the new IMPROVE formula. Appendix D includes a printout of excerpts of CALPOST list files for the exemption modeling that was conducted.

Figure 1-1 Location of Class I Areas in Relation to IP Franklin Mill



2.0 Source Description and Emissions Data

Emissions data from the BART-eligible units at IP Franklin that were used to assess the visibility impacts at the Class I areas within 300 km of the mill are discussed in this section. The SO₂, NOx and PM₁₀ emission rates for each unit that was modeled were determined by ENSR based on information provided by IP Franklin. As described in the site-specific modeling protocol, these rates are representative of each unit's worst-case 24-hour average actual emission rate (excluding startup, shutdown, and malfunction) for the years 2001 to 2004. Note that VISTAS states have concluded that VOC emissions should not be subject to BART based on regional modeling showing that the impact of anthropogenic VOC sources on visibility in the VISTAS region is insignificant.

For the 2001-2004 time period, IP Franklin does not have a continuous record of emissions rates for any of the BART-eligible emission units. Consistent with previously submitted annual emissions information, actual short-term emission rates were quantified for the modeling effort using fuel, raw material, and/or product throughput data in combination with either site-specific or published emission factors. Furthermore, neither hourly nor daily throughput data are available; the shortest time period for which throughput information is archived is monthly. Consequently, the highest actual emission rates for each unit were determined by converting the unit's highest monthly emission rate into a daily emission rate (dividing by the actual number of days that the unit operated in that month) using monthly production rate data and appropriate emission factors for each pollutant.

This approach provides an appropriately conservative means to quantify the worst-case daily emission rates during the 2001 – 2004 time period. Because of the size and complexity of its pulp and paper production process, the Franklin Mill operates at a relatively constant day-to-day production level. Therefore, in the absence of daily actual production data, the use of the actual monthly production rates and operating hours for the period provides an adequate basis for emissions quantification.

Furthermore, for each emission unit the actual particulate matter, SO₂ and NOx emission rates were quantified separately. Each calculation utilized the operating conditions which produced the highest baseline emission rates for each pollutant from each unit. Particularly for those units that have multiple fuel or raw material inputs, this approach resulted in different production levels being employed to determine the worst-case emission rate for each different pollutant from each unit.

For instance, the No. 7 Power Boiler fires a mixture of fuels. Coal and wood are the primary fuels; residual oil is also used as a supplemental fuel when necessary (e.g., during periods when fuel feed system maintenance or malfunctions interrupt the supply of either of the primary fuels). The firing rate for each fuel at any point in time depends on a variety of factors, including fuel availability, price, and the amount of steam required by mill operations. Actual NOx, SO₂, and PM emission rates from the boiler vary with the production rate of each fuel: NOx and SO₂ emission rates are highest during periods of high coal firing rates, while PM emission rates are highest during periods of high wood firing rates. Because it is not physically possible for the unit to simultaneously have both high coal and wood firing rates, the highest emission rates of NOx, SO₂, and PM cannot all occur at the same time.

Therefore, this dispersion modeling demonstration conservatively overestimates the visibility impacts that could occur in practice at the Class I areas in the vicinity of the Franklin Mill because the maximum emission rates that were modeled in actuality cannot all occur at the same time.

This approach is also a conservative representation of the emissions profile from the mill because it assumes that the maximum emission rates from each unit occur simultaneously. Under normal operating conditions, maximum emission rates occur from the different units at different times. For example, the emission rates from the recovery boilers are directly proportional to the rate of black liquor firing in each unit. Because a finite quantity of liquor is continuously produced by the pulp mill and burned in the recovery boilers, it is not physically possible for the worst-case emission rates from all three of these units to occur simultaneously. The

highest rate of emissions from the No. 6 Recovery Boiler occurs when liquor firing has been reduced on the other two recovery boilers, and vice-versa. Hence, the methodology used in this analysis (which presumes that the worst-case emission rates from each of the BART-eligible units occurs simultaneously) overestimates the actual visibility impacts that emissions from the mill can cause from a practical perspective on the Class I areas.

IP Franklin is required as a condition of its operating permit to reduce SO₂ emissions associated with operation of some of the BART-eligible emission units at the mill (specifically, batch digesters, the K1 and K2 continuous digesters, and the D, E, and F evaporators). The emission reductions are accomplished via the use of a scrubbing system to remove reduced sulfur compounds from the vent gases from these units prior to the gases being introduced into the mill's power boilers for incineration. The scrubber system is required to achieve a control efficiency of at least 67%. Had this scrubbing system been in operation during the 2001 – 2004 baseline period, actual SO₂ emissions associated with operation of these sources would have been at least 67% lower than they actually were during that period.

The required use of the scrubber in the present mill configuration means that possible impacts on visibility in the three Class I areas in the vicinity of the mill are now currently lower than they were during the baseline period. The emission rates from these sources summarized in Table 2-1 of the site-specific modeling protocol did not account for operation of the scrubber, and as such are inappropriate for use in the exemption modeling. Consequently, the emission rates used for modeling have been adjusted by the scrubber's required control efficiency (as discussed with and agreed to by Virginia DEQ on August 24, 2006) to account for this change in the emissions profile of the mill.

This approach is conservative as well since the scrubbing system actually operates at a higher level of control efficiency than required. In the most recent 12 month period, the control efficiency of the scrubber averaged 79%. Consequently, using the minimum control efficiency required by permit for this adjustment underestimates the actual reduction in emissions that would have occurred had the scrubber been in operation during the baseline period.

Because various components of PM₁₀ emissions have different visibility extinction efficiencies, the PM₁₀ emission rates are divided, or "speciated" into several components. The PM₁₀ emission rates and speciation approach to be used for the modeling described in this protocol is summarized in the bullets below. Detailed information is provided in Appendix A for each of the BART-eligible units.

- Coarse (2.5 µm to 10.0 µm) and fine PM₁₀ (<2.5 µm) emission rates were determined from filterable PM₁₀ emissions based on particle size data from EPA data (AP-42), when available. When EPA data were not available, the coarse and fine fractions were based on conservative assumptions, as noted in Appendix A.
- Fine elemental carbon (EC) emission rates were determined as percentages of fine PM₁₀ emissions based on "best estimates" from "Catalog of Global Emissions Inventories and Emissions Inventory Tools for Black Carbon", when available. When published data were not available, conservative assumptions were used to estimate fine EC emissions.
- For the power boiler, condensable PM₁₀ emissions were determined from EPA emission factors (AP-42), coal sulfur content, and boiler capacity. For the recovery boilers, smelt dissolving tanks, and lime kilns, condensable PM₁₀ emissions were based on NCASI emission factors¹. The NCASI emission factors were applied to the maximum actual operating rates to determine hourly emission rates.

Tables 2-1 and 2-2 provide a summary of the baseline modeling emission parameters that were used in the BART exemption modeling.

¹ Particulate Emissions Data for Pulp and Paper Industry Specific Sources, NCASI, February 9, 2006.

Table 2-1 IP Franklin – Baseline BART Stack Parameters and Criteria Pollutant Emissions

Source / Unit	Location UTM (Zone 17 NAD-83)		Stack Height	Base Elevat ion (MSL)	Diamet er	Gas Exit Veloci ty	Stack Gas Exit Tempera ture	Emissions		
	UTM East	UTM North						SO ₂	NOx	PM ₁₀
	Km	km	m	ft	m	m/s	Deg K	lb/hr	lb/hr	lb/hr
7 PB	328.910	4060.808	75.61	22	4.27	8.99	459.82	687	422	15.0
4 RF	328.883	4060.903	74.39	22	2.44	13.49	422.04	468	56.9	7.19
5 RF	328.877	4060.922	74.39	22	2.52	11.84	408.71	274	51	11.2
6 RF	329.068	4060.977	92.07	22	3.47	11.24	475.37	133	85	11.8
4 SDT	328.931	4060.892	58.84	22	1.52	9.39	347.59	0.8	1.6	11
5 SDT	328.927	4060.908	58.84	22	1.52	6.10	350.93	0.7	1.4	7.2
6 SDT	329.075	4060.948	92.07	22	1.07	7.97	359.26	1.3	2.7	7.5
4 LK	328.954	4060.935	30.49	22	1.52	13.61	349.26	3.4	22.5	38.9
3 LK	328.965	4060.931	26.22	22	1.98	4.91	349.82	2.9	15.5	42.5
5 Slaker	328.996	4060.846	34.40	22	0.91	1.90	349.26			0.4
6 Slaker	328.989	4060.855	34.40	22	0.91	3.38	340.32			4.9
#1 Starch Silo	329.059	4060.543	28.3	22	0.30	4.48	296.30			0.019
#2 Starch Silo	329.065	4060.546	28.3	22	0.30	4.48	296.30			0.019
#3 Starch Silo	329.070	4060.550	28.4	22	0.30	4.48	296.30			0.019
K1 Digester	Discharges via No. 6 or No. 7 Power Boiler Stack SO ₂ only; emissions accounted for in No. 7 Power Boiler emissions							37.0		
K2 Digester								25.8		
D, E and F Evap. Sets								88.6		
Batch Digester System								41.1		

Table 2-2 IP Franklin – Baseline BART Particulate Speciation

Unit	Particle Speciation								
	Total Filterable PM ₁₀	Coarse PM ₁₀	Fine Filterable PM ₁₀			Condensable PM ₁₀			Organic
			Total	Soil	Elemental Carbon (EC)	Total	Inorganic (Soil)	Inorganic (SO ₄)	
All Values in lb/hr									
7P B&W POWER BOILER	15.00	7.00	8.00	7.44	0.56	12.57	0.00	10.06	2.51
4 RECOVERY BOILER, NONDIRECT CONTACT EVAPORATION	7.19	0.72	6.47	6.02	0.45	26.06	14.38	7.41	4.27
5R KRAFT RECOVERY FURNACE, NONDIRECT CONTACT EVAPORATION	11.20	1.12	10.08	9.37	0.71	26.88	14.83	7.64	4.41
6R KRAFT RECOVERY BOILER, DIRECT CONTACT EVAPORATION	11.80	3.45	8.35	7.77	0.58	119.52	70.07	37.73	11.73
4SDT SMELT DISSOLVING TANK	11.00	1.17	9.83	9.60	0.23	0.97	0.56	0.23	0.18
5SDT SMELT DISSOLVING TANK	7.20	0.76	6.44	6.29	0.15	1.00	0.58	0.24	0.19
6SDT SMELT DISSOLVING TANK	7.50	0.79	6.71	6.55	0.16	1.87	1.08	0.44	0.35
4LK LIME KILN	38.90	0.91	37.99	37.10	0.89	1.49	1.12	0.30	0.07
3LK LIME KILN	42.50	0.99	41.51	40.54	0.97	1.21	0.91	0.24	0.06
5SV LIME SLAKER	0.40	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
6SV LIME SLAKER	4.90	0.00	4.90	0.00	0.00	0.00	0.00	0.00	0.00
No. 1 Dry End Starch Silo	0.019	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
No. 2 Dry End Starch Silo	0.019	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
No. 3 Dry End Starch Silo	0.019	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Batch Digester Filling	0.007	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00

Notes: Detailed calculations are provided in Appendix A. Emission units in Table 2-1 that do not emit particulate matter are not included in Table 2-2.

3.0 Input Data to the CALPUFF Model

3.1 General Modeling Procedures

VISTAS has developed five sub-regional 4-km CALMET meteorological databases for three years (2001-2003). The sub-regional modeling domains are strategically designed to cover all potential BART eligible sources within VISTAS states and all PSD Class I areas within 300 km of those sources. The extents of the 4-km sub-regional domains are shown in Figure 4-4 of the VISTAS common BART modeling protocol. The BART exemption modeling for IP Franklin was conducted with 4-km CALMET resolution sub-domain 5. As shown in Figure 3-1, sub-domain 5 covers all of Virginia and the Class I areas needed for the exemption modeling analysis.

A computational grid was developed to be a subset of the sub-domain 5 meteorological grid. The computational grid was designed to include the three Class I areas and the IP Franklin Mill along with a 50-km buffer. The additional 50-km distance allows for a sufficient buffer to enable puffs to re-circulate. The computational grid extent in relation to the sub-domain 5 meteorological grid is shown in Figure 3-1.

USGS 90-meter Digital Elevation Model (DEM) files were used by VISTAS to generate the terrain data at 4-km resolution for input to the 4-km sub-regional CALMET run. Likewise, USGS 90-meter Composite Theme Grid (CTG) files were used by VISTAS to generate the land use data at 4-km resolution for input to the 4-km sub-regional CALMET run.

Three years of MM5 data (2001-2003) were used by VISTAS to generate the 4-km sub-regional meteorological datasets. See Sections 4.3.2 and 4.4.2 in the VISTAS common BART modeling protocol for more detail on the incorporation of MM5 data and surface observations into the CALMET wind field.

All exemption modeling was conducted using the 4-km CALMET data in sub-domain 5 along with a truncated computational grid.

3.2 Air Quality Database (Background Ozone and Ammonia)

Hourly measurements of ozone from all non-urban monitors within and just outside the computational grid, as generated by VISTAS (available at: http://www.src.com/verio/download/sample_files.htm), was used as input to CALPUFF. The model default of 80 ppb was used for the background ozone concentration in the instance when all hourly data was missing for each station. As for the background ammonia value, VISTAS has recommended that a constant background value of 0.5 ppb should be used rather than using ammonia data derived from CMAQ model output. The exemption modeling conducted for the IP Franklin Mill follows these recommendations of VISTAS and uses 0.5 ppb as a constant ammonia background value.

3.3 Natural Conditions and Monthly f(RH) at Class I Areas

There are three Class I areas within 300 km of IP Franklin (as noted in Figure 1-1). For each of the Class I areas, natural background conditions must be established in order to determine a change in natural conditions related to a source's emissions. For the BART exemption modeling, natural background light extinction corresponding to the annual average (EPA 2003) values were used as an initial estimate. This is consistent with the July 10, 2006 protocol approval letter from DEQ that states they will accept the use of the annual average background.

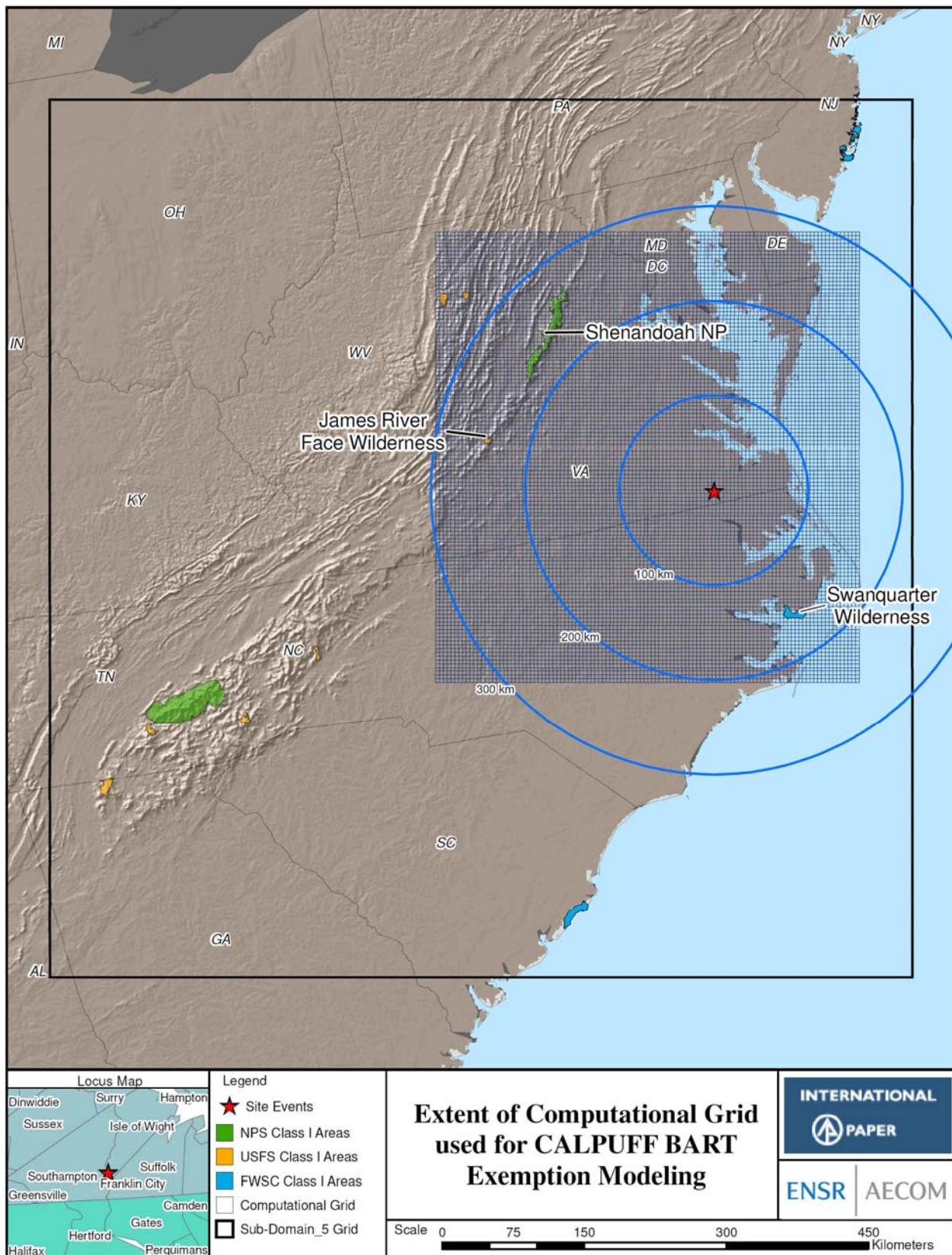
To determine the input to CALPUFF, it is first necessary to convert the deciviews to extinction using the equation:

Extinction (Mm^{-1}) = $10 \exp(\text{deciviews}/10)$.

For example, the EPA guidance document indicates for Swanquarter Wilderness Area that the deciview value for the annual average is 7.38. This is equivalent to an extinction of 20.92 inverse megameters (Mm^{-1}).

This extinction includes the default 10 Mm^{-1} for Rayleigh scattering. The remaining extinction is due to naturally occurring particles, and should be held constant for the entire year's simulation. Therefore, the data provided to CALPOST for Swanquarter was the total annual average natural background extinction minus 10 (Mm^{-1}), or 10.92. This was most easily input as fine soil concentrations ($10.92 \mu\text{g}/\text{m}^3$) in CALPOST, since the extinction efficiency of soil (PM-fine) is 1.0 and there is no f(RH) component. The concentration entries for all other particle constituents were set to zero, and the fine soil concentration was kept the same for each month of the year. The monthly values for f(RH) that CALPOST needs were taken from "Guidance for Tracking Progress Under the Regional Haze Rule" (EPA, 2003) Appendix A, Table A-3. These procedures are consistent with the "base case" VISTAS approach that does not account for site-specific changes to background due to naturally-occurring sea salt and near-sea-level Rayleigh scattering.

IMPROVE has recently approved an alternative to the aerosol extinction formula it uses to estimate natural background visibility that includes the addition of site-specific sea salt and Rayleigh scattering terms to the formula (November 2005). Since the new IMPROVE formula corrects past neglected or incorrectly specified components of visibility background, IP Franklin and ENSR endorse its use for BART analyses. This modeling analysis applied the new IMPROVE formula using the latest revision to the CALPOST spreadsheet developed by Dr. Ivar Tombach, VISTAS technical consultant. The CALPOST spreadsheet (Version 2 dated September 29, 2006) was provided to ENSR by Mike Kiss of DEQ on October 3, 2006. Guidance on application of the new IMPROVE formula is provided in Appendix C. In keeping with DEQ guidance, this report provides visibility calculations using the new IMPROVE equation as well as the existing IMPROVE formula.

Figure 3-1 Extent of Computational Grid

4.0 Air Quality Modeling Procedures

This section provides a summary of the modeling procedures outlined in the VISTAS protocol that were used for the refined CALPUFF BART exemption modeling conducted for the IP Franklin Mill.

4.1 Model Selection and Features

As recommended in the VISTAS protocol, this exemption modeling uses the BART-specific versions of CALMET and CALPUFF posted at http://www.src.com/verio/download/download.htm#VISTAS_VERSION. These versions contain enhancements funded by the Minerals Management Service (MMS) and VISTAS. They are maintained on TRC's website for public access. This release includes CALMET, CALPUFF, CALPOST, CALSUM, and POSTUTIL as well as CALVIEW.

The major features of the CALPUFF modeling system, including those of CALMET and the post-processors (CALPOST and POSTUTIL), are referenced in Section 3 of the VISTAS protocol.

4.2 Modeling Domain and Receptors

The initial IP Franklin BART runs used the 4-km CALMET data in sub-domain #5 that was supplied by VISTAS, as discussed above. A computational grid was developed to be a subset of the sub-domain #5 meteorological grid. The computational grid was designed to include the three Class I areas and the IP Franklin mill along with a 50-km buffer. The additional 50-km distance allowed for a sufficient buffer to enable puffs to re-circulate. The computational grid extent in relation to the sub-domain #5 meteorological grid is shown in Figure 3-1.

The receptors used for each of the Class I areas are based on the NPS database of Class I receptors, as recommended by the VISTAS common protocol (Section 4.3.3).

4.3 Technical Options Used in the Modeling

CALMET modeling for the VISTAS 4-km sub-domains was pre-determined by the VISTAS contractor, and, therefore, we assume that VISTAS approves of the manner in which CALMET has been run for the sub-domain data that they provide.

For CALPUFF model options, IP Franklin followed the VISTAS common BART modeling protocol (Section 4.4.1), which states that we should use IWAQM (EPA, 1998) guidance. The VISTAS protocol also notes that building downwash effects are not required to be included unless the state directs the source to include these effects. Even though the IP Franklin Mill is several tens of kilometers from the nearest Class I area, we chose to include building downwash effects for several of the larger emitting sources in the CALPUFF modeling for accuracy and completeness. The building downwash data was also readily available based on previous modeling studies conducted at the mill.

The POSTUTIL utility program (described in VISTAS common protocol Section 4.4.2) was used to repartition HNO₃ and NO₃ concentrations for all sources using the constant ammonia background value of 0.5 ppb.

4.4 Light Extinction and Haze Impact Calculations

The CALPOST postprocessor was used as prescribed in the VISTAS protocol for the calculation of light extinction due to the impact from the modeled source's primary and secondary particulate matter. The assessment of visibility impacts at the Class I areas used CALPOST Method 6 (as noted in the VISTAS common protocol Section 4.3.2). Each hour's source-caused extinction is calculated by first using the

hygroscopic components of the source-caused concentrations, due to ammonium sulfate and nitrate, and monthly Class I area-specific f(RH) values (see Table 4-1). The contribution to the total source-caused extinction from ammonium sulfate and nitrate is then added to the other, non-hygroscopic components of the particulate concentration (from coarse and fine soil, secondary organic aerosols, and from elemental carbon) to yield the total hourly source-caused extinction.

The existing IMPROVE formula has two well-documented deficiencies (1) lack of sea salt concentration in natural background estimates and (2) lack of site-specific Rayleigh scattering term. As suggested by DEQ in their July 10, 2006 letter to IP Franklin and reaffirmed by Mike Kiss of DEQ on an October 3, 2006 conference call with IP and ENSR, the visibility calculations can be assessed using the new IMPROVE equation. Implementation of the new IMPROVE formula was done in its entirety (rather than using a piecemeal approach) using the latest revision to the CALPOST spreadsheet (Version 2, September 29, 2006) developed by Dr. Ivar Tombach, as furnished by DEQ on October 3, 2006 and found in Appendix C.

The BART rule significance threshold for the contribution to visibility impairment is 0.5 deciviews. The VISTAS protocol (Section 4.3.2) indicates that with the use of the 4-km sub-regional CALMET database, a source does not cause or contribute to visibility impairment if the 98th percentile (or 8th highest) day's change in extinction from natural conditions does not exceed 0.5 deciviews for any of the modeled years. As an added check, the 22nd highest prediction over the three years modeled should also not exceed 0.5 deciviews for a source to be exempted from a BART determination.

The exemption modeling results for the BART-eligible units at IP Franklin are presented in Section 5.

Table 4-1 Annual Average Background and Monthly f(RH) used in CALPOST

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Monthly f(RH)</i>												
James River Face W	2.8	2.6	2.7	2.4	3.0	3.3	3.4	3.7	3.6	3.2	2.8	3.2
Shenandoah NP	3.1	2.8	2.8	2.5	3.1	3.4	3.5	3.9	3.9	3.2	3.0	3.4
Swanquarter NWR	2.9	2.7	2.6	2.5	2.9	3.2	3.4	3.5	3.4	3.1	2.8	3.1
<i>Annual Average Background⁽¹⁾ (Mm⁻¹)</i>												
James River Face W	10.96 (same for all months)											
Shenandoah NP	10.98 (same for all months)											
Swanquarter NWR	10.92 (same for all months)											

(1) Value is adjusted to remove the default Rayleigh scattering coefficient of 10 Mm⁻¹.

5.0 BART Exemption Modeling Results

The exemption modeling results are summarized in Table 5-1. Appendix D provides the delta-deciview results for the top 22 days for each modeled year at each Class I area. The results in Table 5-1 show that the 8th highest day's impacts for each year are below 0.5 dv using the new IMPROVE formula which takes into account site-specific Rayleigh scattering and a Class I-specific sea salt concentration. The evaluation of impacts using the new IMPROVE formula was done using guidance and software provided by VISTAS technical consultant, Dr. Ivar Tombach. Modeling results are also presented in Appendix D using the existing IMPROVE formula. It should be noted that the existing IMPROVE formula approach is overly conservative given the lack of consideration of a site specific Rayleigh scattering value and adjustments to the natural background due to the presence of sea salt concentrations particularly at the Swanquarter Class I area.

Additionally worth noting is that 2002 seems to be an outlier year in terms of impacts at Swanquarter as compared to the other two modeled years. Upon further examination, two days at Swanquarter during 2002 October 14th and 15th, both of which had modeled impacts in the top 10 highest delta-deciviews days for 2002, were influenced by Tropical Storm Kyle as it passed to the east of IP Franklin. This created synoptic conditions with very strong persistent winds from the north-northwest, prime conditions for plume transport from IP Franklin towards Swanquarter. IP recognizes that a tropical storm in October along the east coast is not uncommon, however when such an event occurs, it is highly unlikely that the impacts from a sources emissions on regional haze could ruin a visitors experience in the Class I area, which would likely be closed to the public, if not under mandatory evacuation.

In conclusion, the new IMPROVE formula results demonstrate that the IP Franklin BART eligible units do not cause or contribute to visibility impairment in Class I areas. Based on the modeling information and results presented in this report, the IP Franklin mill is not subject to BART and should be exempt from any additional BART regulatory requirements.

The relevant electronic files used to conduct the CALPUFF modeling are submitted separately on CD-ROM or DVD media.

Table 5-1 Summary of Results – IP Franklin Refined BART Exemption Modeling

Class I Area	Distance (km) from source to Class I area boundary	# of days with impact > 0.5 dv in Class I area				Max. 24-hr impact over 3- yr period (dv)	8 th highest impact over 3- yr period (dv)
		2001	2002	2003	3-yr		
New IMPROVE Formula							
James River Face, VA	~ 240 km	0	0	0	0	0.45	0.25
Shenandoah, VA	~ 225 km	0	1	3	4	1.15	0.25
Swanquarter, NC	~ 140 km	2	4	1	7	0.85	0.41

Appendix A:

Source-Specific Emissions Data for BART Baseline Case

Source-Specific Emissions Data for BART Baseline Case

EMISSION UNIT ID	EMISSION UNIT DESCRIPTION	EMISSION PROCESS DESCRIPTION	MAX ACTUAL DAILY OPERATING RATE (MMBtu/hr, ton BLS/hr, or dscfm) (2001-2004)	CONTROL DEVICE	SHORT TERM EMISSIONS, lb/hr (for the highest emitting day)											
					PM 10		PM ₁₀ Emissions		Filterable				Condensable			
					POTENTIAL	ACTUAL (a)	Total PM ₁₀ Emissions (filterable + condensable)	Total	Coarse	Fine Total	Fine Soil	Fine Elemental Carbon	Total	CPM IOR	Soil	Sulfates
4	7P B&W POWER BOILER (b)	7P B&W-BIT COAL	233 MMBtu/hr	Electrostatic Precipitator	9.40	15.00	27.57	15.00	7.00 (c)	8.00 (c)	7.44	0.56 (d)	12.57 (e)	0.00 (e)	10.06 (e)	2.51 (e)
		7P B&W #6 OIL BOILER		Electrostatic Precipitator	0.80											
		7P B&W Wood		Electrostatic Precipitator	16.30											
		7P B&W-TRS GASES		Combustion												
6	4 RECOVERY BOILER, NONDIRECT CONTACT EVAPORATION	4R KRAFT RECOVERY FURNACE	41.1 ton BLS/hr	Electrostatic Precipitator	8.50	7.19	33.25	7.19	0.72 (f)	6.47 (f)	6.02 (g)	0.45 (g)	26.06 (h)	14.38 (h)	7.41 (h)	4.27 (h)
		4R IN PROCESS FUEL/#6-OIL		Electrostatic Precipitator	0.10											
7	5R KRAFT RECOVERY FURNACE, NONDIRECT CONTACT EVAPORATION	5R KRAFT RECOVERY FURNACE	42.4 ton BLS/hr	Electrostatic Precipitator	12.80	11.20	38.08	11.2	1.12 (f)	10.08 (f)	9.37 (g)	0.71 (g)	26.88 (h)	14.83 (h)	7.64 (h)	4.41 (h)
		5R IN PROCESS FUEL/#6-OIL		Electrostatic Precipitator	0.10											
8	6R KRAFT RECOVERY BOILER, DIRECT CONTACT EVAPORATION	6R KRAFT RECOVERY FURNACE	79.3 ton BLS/hr	Electrostatic Precipitator	13.70	11.80	131.32	11.8	3.45 (i)	8.35 (i)	7.77 (g)	0.58 (g)	119.52 (j)	70.07 (j)	37.73 (j)	11.73 (j)
		6R IN PROCESS FUEL/#6-OIL		Electrostatic Precipitator	0.30											
9	4SDT SMELT DISSOLVING TANK	4SDT SMELT DISSOLVING TK	41.1 ton BLS/hr	Wet Scrubber	11.50	11.00	11.97	11.00	1.17 (k)	9.83 (k)	9.60 (l)	0.23 (l)	0.97 (m)	0.56 (m)	0.23 (m)	0.18 (m)
10	5SDT SMELT DISSOLVING TANK	5SDT SMELT DISSOLVING TK	42.4 ton BLS/hr	Wet Scrubber	8.20	7.20	8.20	7.20	0.76 (k)	6.44 (k)	6.29 (l)	0.15 (l)	1.00 (m)	0.58 (m)	0.24 (m)	0.19 (m)
11	6SDT SMELT DISSOLVING TANK	6SDT SMELT DISSOLVING TK	79.3 ton BLS/hr	Wet Scrubber	8.60	7.50	9.37	7.50	0.79 (k)	6.71 (k)	6.55 (l)	0.16 (l)	1.87 (m)	1.08 (m)	0.44 (m)	0.35 (m)
12	4LK LIME KILN	4LK LIME KILN	27,516 dscfm	Wet Scrubber	47.60	38.90	40.39	38.90	0.91 (n)	37.99 (n)	37.10 (l)	0.89 (l)	1.49 (o)	1.12 (o)	0.30 (o)	0.07 (o)
14	3LK LIME KILN	3LK LIME KILN	22,370 dscfm	Wet Scrubber	53.00	42.50	43.71	42.50	0.99 (n)	41.51 (n)	40.54 (l)	0.97 (l)	1.21 (o)	0.91 (o)	0.24 (o)	0.06 (o)
23	5SV LIME SLAKER	5SV LIME SLAKER	41.7 ADTP/hr	Venturi Scrubber	0.70	0.40	0.40	0.40	0	0.40 (p)	0	0	0	0	0	0
24	6SV LIME SLAKER	6SV LIME SLAKER	40.9 ADTP/hr	Venturi Scrubber	6.90	4.90	4.90	4.90	0	4.90 (p)	0	0	0	0	0	0
	No. 1 Dry End Starch Silo	No. 1 Dry End Starch Silo		Fabric Filter	0.019	0.019	0.02	0.019	0	0.02 (p)	0	0	0	0	0	0
	No. 2 Dry End Starch Silo	No. 2 Dry End Starch Silo		Fabric Filter	0.019	0.019	0.02	0.019	0	0.02 (p)	0	0	0	0	0	0
	No. 3 Dry End Starch Silo	No. 3 Dry End Starch Silo		Fabric Filter	0.019	0.019	0.02	0.019	0	0.02 (p)	0	0	0	0	0	0
	Batch Digester Filling	Batch Digester Filling			0.007	0.007	0.01	0.007	0	0.01 (p)	0	0	0	0	0	0

Includes only those BART-eligible sources at the mill that emit particulate matter.

- (a) Highest hourly actual emissions are based on the operating period between years 2001 and 2004. These emissions values are the highest values for each unit for that period.
- (b) Particle size and condensable emissions are based on coal combustion.
- (c) Coarse PM₁₀ is (1.040/0.75) x filterable PM₁₀ based on Table 1.1-7 in AP-42. Fine PM₁₀ is the difference between filterable PM₁₀ and coarse PM₁₀.
- (d) 7.0% of fine PM₁₀ based on the average of the best estimates for industrial coal and wood combustion in Table 6 of "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", William Battye and Kathy Boyer, EPA Contract No. 68-D-98-046, January 2002.
- (e) Condensable PM₁₀ based on AP-42, Table 1.1-5 and boiler capacity. Total condensable PM₁₀ = 0.1S-0.03 lb/MMBtu. Inorganic is 80% of total and organic is 20% of total. Inorganics assumed to be sulfates. Coal during the period of maximum emissions contained 0.84% S.
- (f) Coarse PM₁₀ is (1-0.67.3/0.74.8) x filterable PM₁₀ based on Table 1.1-7 in AP-42. Fine PM₁₀ is the difference between filterable PM₁₀ and coarse PM₁₀.
- (g) There are no data on elemental or black carbon (EC) for this source type. Emissions are based on 7% of fine PM₁₀. This assumption is based on the "best estimate" of 6.7% for natural gas combustion and 7.4% for oil in Table 6 of "Catalog of Global Emissions Inventories and Emission Inventory Tools for Black Carbon", William Battye and Kathy Boyer, EPA Contract No. 68-D-98-046, January 2002.
- (h) Condensable PM₁₀ (CPM) emissions are based on NCASI emission factors (Particulate Emissions for Pulp and Paper Industry Specific Sources, February 9, 2006). This is a nondirect contact evaporation recovery furnace. The emissions factors are 0.53 lb/ton of BLS for CPM Inorganic (IOR) and 0.104 lb/ton of BLS for CPM organic (OR). Sulfates, based on ion chromatography, are 34% of the CPM IOR.
- (i) Coarse PM₁₀ is (1-0.538/0.76) x filterable PM₁₀, based on Table 10.2-2 in AP-42. 76% of filterable PM₁₀ is extrapolated from Figure 10.2-2. Fine PM₁₀ is the difference between filterable PM₁₀ and coarse PM₁₀.
- (j) Condensable PM₁₀ emissions are based on NCASI emission factors (Particulate Emissions for Pulp and Paper Industry Specific Sources, February 9, 2006). This is a direct contact evaporation recovery furnace. The emissions factors are 1.36 lb/ton of BLS for CPM IOR and 0.148 lb/ton of BLS for CPM OR. Sulfates, based on ion chromatography, are 35% of the CPM IOR.
- (k) Coarse PM₁₀ is (1-0.852/0.953) x filterable PM₁₀, based on Table 10.2-6 in AP-42. Fine PM₁₀ is the difference between filterable PM₁₀ and coarse PM₁₀.
- (l) There are no data on EC for this source type. PM₁₀ emissions from smelt tanks and lime kilns are likely virtually all inorganic given the nature of the processes. Therefore, as a conservative estimate, it is assumed that 2.33% of fine PM₁₀ (1/3 of the percentage assumed for the recovery boilers) is EC.
- (m) Condensable PM₁₀ emissions are based on NCASI emission factors (Particulate Emissions for Pulp and Paper Industry Specific Sources, February 9, 2006). The emissions factors are 0.0192 lb/ton of BLS for CPM IOR and 0.0044 lb/ton of BLS for CPM OR. Sulfates, based on ion chromatography, are 29% of the CPM IOR.
- (n) Coarse PM₁₀ is (1-0.960/0.983) x filterable PM₁₀, based on Table 10.2-4 in AP-42. Fine PM₁₀ is the difference between filterable PM₁₀ and coarse PM₁₀.
- (o) Condensable PM₁₀ emissions are based on NCASI emission factors (Particulate Emissions for Pulp and Paper Industry Specific Sources, February 9, 2006). The emissions factors are 0.0060 gr/dscf @10% O₂ for CPM IOR and 0.00030 gr/dscf @10% O₂ for CPM OR. Sulfates, based on ion chromatography, are 21% of the CPM IOR. Stack gas flow is calculated from the stack parameters assuming saturation and 10% O₂ on a dry basis.
- (p) All PM₁₀ is conservatively assumed to be fine PM₁₀. Based on the type of source, these sources are not expected to emit EC or CPM.

Appendix B:

NCASI Particulate Emissions Data for Pulp and Paper Industry Specific Sources

Particulate Emissions Data for Pulp and Paper Industry Specific Sources

The following tables contain summarized particulate emissions data for sources that are specific to the pulp and paper industry. The source categories addressed in this document are smelt dissolving tanks, lime kilns, and recovery furnaces. Boilers are not addressed since AP-42 emission factors for boiler emissions are well documented and readily available including in NCASI Technical Bulletin No. 884.

Smelt Dissolving Tanks

Data for smelt dissolving tanks were compiled from NCASI Technical Bulletins Nos. 884 and 898. This data set includes test results from the use of a dilution tunnel method which quantifies total PM₁₀ and PM_{2.5} particulate matter. Total PM₁₀ and PM_{2.5} particulate matter are the sum of filterable and condensable PM₁₀ and PM_{2.5} particulate matter. All smelt dissolving tanks in the data set have wet particulate control devices.

The filterable PM numbers are obtained from combining the data set of 36 sources listed in NCASI Technical Bulletin No. 884, Table A15c, and the data set of 6 sources listed in NCASI Technical Bulletin No. 898. The data for "Total PM₁₀" and "Total PM_{2.5}" are from the 8 sources listed in NCASI Technical Bulletin No. 884, Table A15d. All of the CPM data was from the 6 sources listed in NCASI Technical Bulletin No. 898. The CPM data listed in Technical Bulletin No. 884 was not used as that data is an estimate of CPM and not results from EPA Method 202. All of the sulfate data is from the 3 sources tested by NCASI, and listed in Technical Bulletin No. 898.

Table 1: Smelt Tank Data Summary

Parameter	Measurement Method	No. of Sources	Range	Mean	⁵ Mean Percent of PM
			(lb/ton BLS)		
PM	EPA Method 5	42	0.03 - 0.64	0.148	
⁶ Total PM ₁₀	Dilution Tunnel	8	¹ 0.031 – 0.666	² 0.154	⁶ 104
⁶ Total PM _{2.5}	Dilution Tunnel	7	¹ 0.027 – 0.570	² 0.132	⁶ 89
CPM MeCl ₂ Soluble	EPA 202	6	¹ 0.0009 - 0.0192	² 0.0044	3
CPM Water Soluble	EPA 202	6	¹ 0.0039 - 0.0832	² 0.0192	13
CPM	EPA Method 202	6	¹ 0.0048 - 0.1024	² 0.0237	16
Sulfate	IC	3	³ 0.0014 - 0.0297	⁴ 0.0069	% of CPM = 29

¹Range values were determined by applying the mean percent of PM to the range of values for PM. ²Mean values were determined by applying the mean percent of PM to mean value for PM. ³Range values for sulfate were determined by applying the mean percent of CPM to the range of CPM values. ⁴Mean value for sulfate was determined by applying the mean percent of CPM to the mean value for CPM. ⁵Mean percent of PM values are derived from individual data sets. ⁶Values include filterable and condensable PM.

Recovery Furnaces

The recovery furnace data are a compilation of data in NCASI Technical Bulletins Nos. 852, 884, and as yet unpublished NCASI data. All of the recovery furnaces in this data set use electrostatic precipitators (ESP) for particulate control.

The PM data for DCE recovery furnaces is from the 23 sources listed in NCASI Technical Bulletin No. 884, Table A11c. The PM₁₀ data for the DCE recovery furnaces is from the 4 DCE sources listed in Technical Bulletin No. 884, Table A11d. The PM_{2.5} data for DCE recovery furnaces is from the 4 DCE sources listed in Technical Bulletin No. 884, Table A11d, plus a further two from as yet unpublished NCASI data. The DCE CPM data is from two sources listed in Technical Bulletins Nos. 852 and 884, and two sources from as yet unpublished NCASI data.

The PM data for the NDCE recovery furnaces is from the 20 sources listed in NCASI Technical Bulletin No. 884, Table A12b. The PM₁₀ data for the NDCE recovery furnaces is from the 13 NDCE sources listed in Technical Bulletin No. 884, Table A12c. The PM_{2.5} data for NDCE recovery furnaces is from the 11 DCE sources listed in Technical Bulletin No. 884, Table A12c, plus a further source from as yet unpublished NCASI data. The NDCE CPM data is from 6 sources listed in Technical Bulletin No. 884, and one source from as yet unpublished NCASI data.

Table 2: Recovery Furnace Data Summary

Kraft DCE Recovery Furnace					
Parameter	Measurement Method	No. of Sources	Range (lb/ton BLS)	Mean	⁵ Mean Percent of PM
PM	EPA Method 5	23	0.07 - 2.58	0.74	
PM ₁₀	EPA CTM-040	4	¹ 0.05 - 1.88	² 0.54	73
PM _{2.5}	EPA CTM-040	6	¹ 0.04 - 1.44	² 0.41	56
CPM MeCl ₂ Soluble	EPA 202	4	¹ 0.014 - 0.516	² 0.148	20
CPM Water Soluble	EPA 202	4	¹ 0.13 - 4.75	² 1.36	184
CPM	EPA Method 202	4	¹ 0.14 - 5.29	² 1.52	205
Sulfate	IC	3	³ 0.05 - 1.85	⁴ 0.53	% of CPM = 35

Kraft NDCE Recovery Furnace					
Parameter	Measurement Method	No. of Sources	Range (lb/ton BLS)	Mean	⁵ Mean Percent of PM
PM	EPA Method 5	20	0.02 - 3.50	0.65	
PM ₁₀	EPA CTM-040	13	¹ 0.01 - 2.35	² 0.44	67
PM _{2.5}	EPA CTM-040	11	¹ 0.01 - 1.82	² 0.34	52
CPM MeCl ₂ Soluble	EPA 202	3	¹ 0.003 - 0.560	² 0.104	16
CPM Water Soluble	EPA 202	3	¹ 0.016 - 2.84	² 0.53	81
CPM	EPA Method 202	7	¹ 0.02 - 3.40	² 0.63	97
Sulfate	IC	2	³ 0.007 - 1.16	⁴ 0.21	% of CPM = 34

¹Range values were determined by applying the mean percent of PM to the range of values for PM. ²Mean values were determined by applying the mean percent of PM to the mean value for PM. ³Range values for sulfate were determined by applying the mean percent of CPM to the range of CPM values. ⁴Mean value for sulfate was determined by applying the mean percent of CPM to the mean value for CPM. ⁵Mean percent of PM values are derived from individual data sets.

Lime Kilns

The lime kiln data are a compilation of data from NCASI Technical Bulletins Nos. 852, 884, and 898. The emissions data are separated by control device type. The majority of lime kilns in this data set use wet control devices for particulate control. Two of the lime kilns in this data set use an ESP for particulate control, followed by a wet scrubber for SO₂ control. The remainder use an ESP for particulate control.

The PM data for lime kilns using wet control devices is from 30 sources listed in NCASI Technical Bulletin No. 884, Table A13c. The PM₁₀ and PM_{2.5} data for lime kilns using wet control devices is from NCASI Technical Bulletin No. 884, Table A13d. The CPM and sulfate data for lime kilns using wet control devices is from Technical Bulletin No. 898.

All of the PM, CPM, and sulfate data for lime kilns using an ESP followed by a wet control device is from two sources listed in NCASI Technical Bulletin No. 898.

The PM data for lime kilns using an ESP alone are from the 7 sources listed in NCASI Technical Bulletin No. 884, Table A13c. The PM₁₀ and PM_{2.5} data are from the 6 sources listed in Technical Bulletin No. 884, Table A13d. The CPM and sulfate data are from 3 sources listed NCASI Technical Bulletin Nos. 852 and 884.

Table 3: Lime Kiln Data Summary

Lime Kilns with Wet Particulate Control Devices					
Parameter	Measurement Method	No. of Sources	Range (gr/dscf) @ 10% O ₂	Mean	⁵ Mean Percent of PM
PM	EPA Method 5	30	0.014 - 0.346	0.0995	
⁶ Total PM ₁₀	Dilution Tunnel	6	¹ 0.014 - 0.349	² 0.100	101
⁶ Total PM _{2.5}	Dilution Tunnel	7	¹ 0.012 - 0.304	² 0.088	88
CPM MeCl ₂ Soluble	EPA Method 202	3	¹ 4.2E-5 - 0.0010	² 0.0003	0.3
CPM Water Soluble	EPA Method 202	3	¹ 0.0008 - 0.0208	² 0.0060	6
CPM	EPA Method 202	3	¹ 0.0009 - 0.0218	² 0.0063	6.3
Sulfate	IC	2	³ 0.0002 - 0.0046	⁴ 0.0013	% of CPM = 21

*These data are the result of dilution tunnel testing, therefore the PM₁₀ and PM_{2.5} values reflect the sum of filterable and condensable PM₁₀ and PM_{2.5} particulate.

Lime Kilns with a Dry ESP for Particulate Control Followed by a Wet Scrubber

Parameter	Measurement Method	No. of Sources	Range (gr/dscf) @ 10% O ₂	Mean	⁵ Mean Percent of PM
PM	EPA Method 5	2	0.003 - 0.004	0.004	
PM ₁₀			No Data	No Data	
PM _{2.5}			No Data	No Data	
CPM MeCl ₂ Soluble	EPA Method 202	2	0.0004 - 0.0081	0.0042	140
CPM Water Soluble	EPA Method 202	2	0.0038 - 0.0054	0.0046	131
CPM	EPA Method 202	2	0.006 - 0.012	0.009	271
Sulfate	IC	1	0.002	0.002	% of CPM = 34

Lime Kilns with a Dry ESP for Particulate Control

Parameter	Measurement Method	No. of Sources	Range (gr/dscf) @ 10% O ₂	Mean	⁵ Mean Percent of PM
PM	EPA Method 5	7	0.002 - 0.033	0.010	
PM ₁₀	EPA CTM-040	6	¹ 0.001 - 0.211	² 0.006	64
PM _{2.5}	EPA CTM-040	6	¹ 0.0005 - 0.0079	² 0.0024	24
CPM MeCl ₂ Soluble	EPA Method 202	3	¹ 0.0013 - 0.0208	² 0.0063	63
CPM Water Soluble	EPA Method 202	3	¹ 0.003 - 0.045	² 0.014	137
CPM	EPA Method 202	3	¹ 0.004 - 0.066	² 0.020	200
Sulfate	IC	3	³ 0.0035 - 0.0581	⁴ 0.0176	% of CPM = 88

¹Range values were determined by applying the mean percent of PM to the range of values for PM. ²Mean values were determined by applying the mean percent of PM to the mean value for PM. ³Range values for sulfate were determined by applying the mean percent of CPM to the range of CPM values. ⁴Mean value for sulfate was determined by applying the mean percent of CPM to the mean value for CPM. ⁵Mean percent of PM values are derived from individual data sets. ⁶Values include filterable and condensable PM.

Appendix C:

New IMPROVE Equation Implementation Procedure

Appendix D:

CALPOST Files: James River Face, Shenandoah, and Swanquarter

Ranked Daily Visibility Change for James River Face (Top 20 Days for 2001 – New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank	
2001	102	0	3	1530.255	-121.206	D	1.238	20.96	22.198	5.91	2.4	1.002	0.179	0.015	0.007	0	0.035	1
2001	141	0	2	1529.538	-121.346	D	1.159	20.96	22.119	5.53	3	1.055	0.054	0.013	0.006	0	0.031	2
2001	343	0	4	1526.493	-121.002	D	1.039	20.96	21.999	4.96	3.2	0.761	0.225	0.013	0.007	0.001	0.033	3
2001	247	0	40	1532.414	-117.026	D	0.838	20.96	21.798	4	3.6	0.756	0.027	0.014	0.007	0.001	0.035	4
2001	329	0	1	1528.821	-121.486	D	0.781	20.96	21.741	3.73	2.8	0.528	0.203	0.013	0.006	0.001	0.03	5
2001	305	0	1	1528.821	-121.486	D	0.753	20.96	21.713	3.59	3.2	0.591	0.099	0.017	0.007	0.001	0.038	6
2001	178	0	3	1530.255	-121.206	D	0.708	20.96	21.668	3.38	3.3	0.639	0.031	0.01	0.005	0	0.024	7
2001	138	0	17	1529.901	-119.397	D	0.692	20.96	21.652	3.3	3	0.471	0.199	0.006	0.003	0	0.014	8
2001	205	0	47	1532.237	-116.121	D	0.642	20.96	21.602	3.06	3.4	0.606	0.004	0.008	0.004	0	0.02	9
2001	103	0	40	1532.414	-117.026	D	0.46	20.96	21.42	2.19	2.4	0.378	0.06	0.006	0.003	0	0.013	10
2001	348	0	3	1530.255	-121.206	D	0.393	20.96	21.353	1.87	3.2	0.297	0.085	0.003	0.001	0	0.007	11
2001	215	0	2	1529.538	-121.346	D	0.344	20.96	21.304	1.64	3.7	0.307	0.026	0.003	0.001	0	0.007	12
2001	142	0	2	1529.538	-121.346	D	0.315	20.96	21.275	1.5	3	0.233	0.068	0.003	0.002	0	0.008	13
2001	253	0	47	1532.237	-116.121	D	0.289	20.96	21.249	1.38	3.6	0.271	0.004	0.003	0.002	0	0.009	14
2001	129	0	40	1532.414	-117.026	D	0.223	20.96	21.183	1.06	3	0.176	0.031	0.004	0.002	0	0.01	15
2001	252	0	52	1528.3	-115.014	D	0.189	20.96	21.149	0.9	3.6	0.175	0.008	0.001	0.001	0	0.004	16
2001	251	0	11	1531.512	-120.021	D	0.184	20.96	21.144	0.88	3.6	0.176	0.001	0.002	0.001	0	0.004	17
2001	229	0	40	1532.414	-117.026	D	0.148	20.96	21.108	0.71	3.7	0.142	0.001	0.001	0.001	0	0.003	18
2001	216	0	11	1531.512	-120.021	D	0.139	20.96	21.099	0.66	3.7	0.131	0.004	0.001	0	0	0.002	19
2001	214	0	11	1531.512	-120.021	D	0.138	20.96	21.098	0.66	3.7	0.123	0.001	0.001	0	0	0.004	20
2001	56	0	4	1526.493	-121.002	D	0.135	20.96	21.095	0.64	2.6	0.098	0.023	0.003	0.002	0	0.009	21
2001	284	0	40	1532.414	-117.026	D	0.128	20.96	21.088	0.61	3.2	0.093	0.028	0.002	0.001	0	0.004	22

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
7.97	7.40	0.57
7.94	7.40	0.54
7.88	7.40	0.48
7.79	7.40	0.39
7.77	7.40	0.37
7.75	7.40	0.35
7.73	7.40	0.33
7.73	7.40	0.32
7.70	7.40	0.30
7.62	7.40	0.22
7.59	7.40	0.19
7.56	7.40	0.16
7.55	7.40	0.15
7.54	7.40	0.14
7.51	7.40	0.11
7.49	7.40	0.09
7.49	7.40	0.09
7.47	7.40	0.07
7.47	7.40	0.07
7.47	7.40	0.07
7.46	7.40	0.06
7.46	7.40	0.06

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

11

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

0.02

6. Enter desired NO₂/NO_x ratio (default is 0)

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Source	BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	Rank	New			
																			dv(total)	dv(bkg)	Δdv	
2001	102	0	3	1530.255	-121.206	D	0.948	21.00	21.953	4.56	73	0.75	0.145	0.012	0.007	0	0.035	0	1	7.86	7.42	0.45
2001	141	0	2	1529.538	-121.346	D	0.883	21.48	22.367	4.15	81	0.792	0.044	0.01	0.006	0	0.031	0	2	8.05	7.64	0.41
2001	343	0	4	1526.493	-121.002	D	0.813	21.67	22.484	3.78	83	0.577	0.185	0.01	0.007	0.001	0.033	0	3	8.10	7.73	0.37
2001	247	0	40	1532.414	-117.026	D	0.697	22.21	22.917	3.16	87	0.619	0.024	0.011	0.007	0.001	0.035	0	4	8.29	7.98	0.31
2001	329	0	1	1528.821	-121.486	D	0.610	21.33	21.945	2.88	79	0.397	0.165	0.01	0.006	0.001	0.03	0	5	7.86	7.58	0.28
2001	305	0	1	1528.821	-121.486	D	0.588	21.67	22.258	2.74	83	0.448	0.081	0.013	0.007	0.001	0.038	0	6	8.00	7.73	0.27
2001	178	0	3	1530.255	-121.206	D	0.553	21.78	22.338	2.56	84	0.491	0.026	0.008	0.005	0	0.024	0	7	8.04	7.78	0.25
2001	138	0	17	1529.901	-119.397	D	0.536	21.48	22.016	2.51	81	0.353	0.161	0.005	0.003	0	0.014	0	8	7.89	7.64	0.25
2001	205	0	47	1532.237	-116.121	D	0.506	21.90	22.413	2.33	85	0.473	0.003	0.006	0.004	0	0.02	0	9	8.07	7.84	0.23
2001	103	0	40	1532.414	-117.026	D	0.351	21.00	21.350	1.69	73	0.282	0.048	0.005	0.003	0	0.013	0	10	7.58	7.42	0.17
2001	348	0	3	1530.255	-121.206	D	0.305	21.67	21.972	1.42	83	0.225	0.07	0.002	0.001	0	0.007	0	11	7.87	7.73	0.14
2001	215	0	2	1529.538	-121.346	D	0.277	22.21	22.494	1.26	87	0.244	0.022	0.002	0.001	0	0.007	0	12	8.11	7.98	0.12
2001	142	0	2	1529.538	-121.346	D	0.242	21.48	21.720	1.13	81	0.174	0.055	0.002	0.002	0	0.008	0	13	7.76	7.64	0.11
2001	253	0	47	1532.237	-116.121	D	0.238	22.21	22.455	1.08	87	0.222	0.004	0.002	0.002	0	0.009	0	14	8.09	7.98	0.11
2001	129	0	40	1532.414	-117.026	D	0.172	21.48	21.650	0.81	81	0.132	0.025	0.003	0.002	0	0.01	0	15	7.72	7.64	0.08
2001	252	0	52	1528.3	-115.014	D	0.156	22.21	22.372	0.71	87	0.143	0.007	8E-04	0.001	0	0.004	0	16	8.05	7.98	0.07
2001	251	0	11	1531.512	-120.021	D	0.151	22.21	22.367	0.69	87	0.144	9E-04	0.002	0.001	0	0.004	0	17	8.05	7.98	0.07
2001	229	0	40	1532.414	-117.026	D	0.119	22.21	22.334	0.54	87	0.113	9E-04	8E-04	0.001	0	0.003	0	18	8.04	7.98	0.05
2001	216	0	11	1531.512	-120.021	D	0.110	22.21	22.326	0.50	87	0.104	0.003	8E-04	0	0.002	0	20	8.03	7.98	0.05	
2001	214	0	11	1531.512	-120.021	D	0.112	22.21	22.327	0.51	87	0.098	0.009	8E-04	0.001	0	0.004	0	19	8.03	7.98	0.05
2001	56	0	4	1526.493	-121.002	D	0.104	21.14	21.248	0.50	76	0.073	0.018	0.002	0.002	0	0.009	0	21	7.54	7.49	0.05
2001	28																					

Ranked Daily Visibility Change for James River Face (Top 20 Days for 2002 – New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank
2002	42	0	29	1531.875	-118.071 D	0.749	20.96	21.709	3.57	2.6	0.377	0.283	0.023	0.011	0	0.055	1
2002	216	0	3	1530.255	-121.206 D	0.514	20.96	21.474	2.45	3.7	0.493	0.002	0.004	0.002	0	0.012	2
2002	204	0	11	1531.512	-120.021 D	0.414	20.96	21.374	1.98	3.4	0.398	0.003	0.003	0.002	0	0.008	3
2002	80	0	40	1532.414	-117.026 D	0.389	20.96	21.349	1.86	2.7	0.193	0.157	0.01	0.005	0	0.024	4
2002	239	0	47	1532.237	-116.121 D	0.344	20.96	21.304	1.64	3.7	0.328	0.002	0.003	0.002	0	0.009	5
2002	195	0	47	1532.237	-116.121 D	0.333	20.96	21.293	1.59	3.4	0.309	0.003	0.005	0.003	0	0.013	6
2002	86	0	11	1531.512	-120.021 D	0.327	20.96	21.287	1.56	2.7	0.204	0.103	0.005	0.002	0	0.012	7
2002	183	0	11	1531.512	-120.021 D	0.294	20.96	21.254	1.4	3.4	0.282	0.002	0.003	0.001	0	0.006	8
2002	284	0	1	1528.821	-121.486 D	0.257	20.96	21.217	1.22	3.2	0.215	0.031	0.003	0.001	0	0.006	9
2002	274	0	11	1531.512	-120.021 D	0.244	20.96	21.204	1.17	3.6	0.214	0.018	0.003	0.002	0	0.008	10
2002	184	0	11	1531.512	-120.021 D	0.222	20.96	21.182	1.06	3.4	0.216	0.001	0.001	0.001	0	0.004	11
2002	353	0	1	1528.821	-121.486 D	0.205	20.96	21.165	0.98	3.2	0.121	0.069	0.004	0.002	0	0.009	12
2002	208	0	3	1530.255	-121.206 D	0.203	20.96	21.163	0.97	3.4	0.183	0.018	0.001	0	0	0.001	13
2002	172	0	3	1530.255	-121.206 D	0.193	20.96	21.153	0.92	3.3	0.132	0.041	0.005	0.002	0	0.012	14
2002	104	0	2	1529.538	-121.346 D	0.19	20.96	21.115	0.91	2.4	0.15	0.03	0.002	0.001	0	0.006	15
2002	151	0	40	1532.414	-117.026 D	0.189	20.96	21.149	0.9	3	0.168	0.006	0.004	0.002	0	0.009	16
2002	41	0	11	1531.512	-120.021 D	0.18	20.96	21.14	0.86	2.6	0.11	0.047	0.006	0.003	0	0.015	17
2002	354	0	40	1532.414	-117.026 D	0.169	20.96	21.129	0.81	3.2	0.111	0.045	0.003	0.002	0	0.008	18
2002	185	0	11	1531.512	-120.021 D	0.17	20.96	21.13	0.81	3.4	0.166	0	0.001	0	0	0.002	19
2002	62	0	11	1531.512	-120.021 D	0.17	20.96	21.13	0.81	2.7	0.099	0.058	0.003	0.002	0	0.008	20
2002	150	0	3	1530.255	-121.206 D	0.158	20.96	21.118	0.75	3	0.143	0.002	0.003	0.002	0	0.008	21
2002	73	0	47	1532.237	-116.121 D	0.149	20.96	21.109	0.71	2.7	0.128	0.018	0.001	0	0	0.002	22

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
7.75	7.40	0.35
7.64	7.40	0.24
7.60	7.40	0.20
7.58	7.40	0.18
7.56	7.40	0.16
7.56	7.40	0.15
7.54	7.40	0.14
7.52	7.40	0.12
7.52	7.40	0.12
7.51	7.40	0.11
7.50	7.40	0.10
7.50	7.40	0.10
7.49	7.40	0.09
7.49	7.40	0.09
7.49	7.40	0.09
7.49	7.40	0.09
7.49	7.40	0.09
7.48	7.40	0.08
7.48	7.40	0.08
7.48	7.40	0.08
7.47	7.40	0.07

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

11
0.02

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

6. Enter desired NO₂/NOx ratio (default is 0)

--

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Source	BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	Rank	New	dv(total)	dv(bkg)	Δdv
2002	42	0	29	1531.875	-118.071 D	0.591	21.14	21.739	2.82	76	0.28	0.228	0.018	0.011	0	0.055	0	1	7.77	7.49	0.28	
2002	216	0	3	1530.255	-121.206 D	0.411	22.21	22.629	1.87	87	0.392	0.002	0.003	0.002	0	0.012	0	2	8.17	7.98	0.18	
2002	204	0	11	1531.512	-120.021 D	0.325	21.90	22.230	1.50	85	0.31	0.003	0.002	0.002	0	0.008	0	3	7.99	7.84	0.15	
2002	80	0	40	1532.414	-117.026 D	0.311	21.26	21.575	1.47	78	0.146	0.129	0.008	0.005	0	0.024	0	4	7.69	7.54	0.15	
2002	239	0	47	1532.237	-116.121 D	0.276	22.21	22.493	1.25	87	0.261	0.002	0.002	0.002	0	0.009	0	5	8.11	7.98	0.12	
2002	195	0	47	1532.237	-116.121 D	0.263	21.90	22.168	1.21	85	0.241	0.003	0.004	0.003	0	0.013	0	7	7.96	7.84	0.12	
2002	86	0	11	1531.512	-120.021 D	0.256	21.26	21.519	1.21	78	0.154	0.084	0.004	0.002	0	0.012	0	6	7.66	7.54	0.12	
2002	183	0	11	1531.512	-120.021 D	0.231	21.90	22.135	1.06	85	0.22	0.002	0.002	0.001	0	0.006	0	8	7.95	7.84	0.11	
2002	284	0	1	1528.821	-121.486 D	0.197	21.67	21.864	0.92	83	0.163	0.025	0.002	0.001	0	0.006	0	10	7.82	7.73	0.09	
2002	274	0	11	1531.512	-120.021 D	0.203	22.21	22.419	0.92	87	0.175	0.016	0.002	0.002	0	0.008	0	9	8.07	7.98	0.09	
2002	184	0	11	1531.512	-120.021 D	0.175	21.90	22.079	0.80	85	0.168	8E-04	8E-04	0.001	0	0.004	0	11	7.92	7.84	0.08	
2002	353	0	1	1528.821	-121.486 D	0.162	21.67	21.828	0.75	83	0.091	0.057	0.003	0.002	0	0.009	0	12	7.81	7.73	0.08	
2002	208	0	3	1530.255	-121.206 D	0.160	21.90	22.063	0.73	85	0.143	0.015	8E-04	0	0	0.001	0	13	7.91	7.84	0.07	
2002	172	0	3	1530.255	-121.206 D	0.153	21.78	21.935	0.71	84	0.101	0.034	0.004	0.002	0	0.012	0	14	7.85	7.78	0.07	
2002	104	0	2	1529.538	-121.346 D	0.144	21.00	21.142	0.69	73	0.112	0.024	0.002	0.001	0	0.006	0	15	7.49	7.42	0.07	
2002	151	0	40	1532.414	-117.026 D	0.145	21.48	21.623	0.68	81	0.126	0.005	0.003	0.002	0	0.009	0	16	7.71	7.64	0.07	
2002	41	0	11	1531.512	-120.021 D	0.142	21.14	21.286	0.68	76	0.081	0.038	0.005	0.003	0	0.015	0	17	7.55	7.49	0.07	
2002	354	0	40	1532.414	-117.026 D	0.133	21.67	21.799	0.62	83	0.084	0.037	0.002	0.002	0	0.008	0	19	7.79	7.73	0.06	
2002	185	0	11	1531.512	-120.021 D	0.132	21.90	22.036	0.61	85	0.129	0	8E-04	0	0	0.002	0	20	7.90	7.84	0.06	
2002	62	0	11	1531.512	-120.021 D	0.134	21.26	21.397	0.64	78	0.075	0.047	0.002	0.002	0	0.008	0	18	7.61	7.54	0.06	
2002	150	0	3	1530.255	-121.206 D	0.121	21.48	21.599	0.57	81	0.107	0.002	0.002	0.002	0	0.008	0	21	7.70	7.64	0.06	
2002	73	0	47	1532.237	-116.121 D	0.114	21.26	21.376	0.54	78	0.097	0.015	8E-04	0	0	0.002	0	22	7.60	7.54	0.05	

Ranked Daily Visibility Change for James River Face (Top 20 Days for 2003 – New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank	
2003	71	0	11	1531.512	-120.021	D	0.965	20.96	21.925	4.61	2.7	0.517	0.353	0.024	0.012	0.001	0.059	1
2003	299	0	40	1532.414	-117.026	D	0.914	20.96	21.874	4.36	3.2	0.677	0.157	0.022	0.009	0.001	0.048	2
2003	345	0	3	1530.255	-121.206	D	0.87	20.96	21.83	4.15	3.2	0.534	0.27	0.012	0.009	0	0.043	3
2003	233	0	3	1530.255	-121.206	D	0.816	20.96	21.776	3.89	3.7	0.778	0.015	0.006	0.003	0	0.015	4
2003	323	0	1	1528.821	-121.486	D	0.761	20.96	21.721	3.63	2.8	0.566	0.153	0.011	0.005	0	0.026	5
2003	283	0	2	1529.538	-121.346	D	0.596	20.96	21.556	2.84	3.2	0.414	0.142	0.01	0.005	0	0.025	6
2003	170	0	11	1531.512	-120.021	D	0.475	20.96	21.435	2.27	3.3	0.398	0.064	0.004	0.001	0	0.008	7
2003	38	0	40	1532.414	-117.026	D	0.427	20.96	21.387	2.04	2.6	0.242	0.153	0.008	0.004	0	0.02	8
2003	266	0	47	1532.237	-116.121	D	0.354	20.96	21.314	1.69	3.6	0.241	0.07	0.011	0.005	0	0.026	9
2003	282	0	40	1532.414	-117.026	D	0.342	20.96	21.302	1.63	3.2	0.296	0.026	0.005	0.002	0	0.012	10
2003	64	0	11	1531.512	-120.021	D	0.284	20.96	21.244	1.36	2.7	0.138	0.114	0.008	0.004	0	0.021	11
2003	88	0	1	1528.821	-121.486	D	0.277	20.96	21.237	1.32	2.7	0.206	0.039	0.008	0.004	0	0.019	12
2003	4	0	1	1528.821	-121.486	D	0.275	20.96	21.235	1.31	2.8	0.157	0.098	0.005	0.003	0	0.013	13
2003	147	0	40	1532.414	-117.026	D	0.257	20.96	21.217	1.22	3	0.212	0.034	0.002	0.001	0	0.006	14
2003	144	0	2	1529.538	-121.346	D	0.233	20.96	21.193	1.11	3	0.146	0.086	0	0	0	0.001	15
2003	75	0	11	1531.512	-120.021	D	0.234	20.96	21.194	1.11	2.7	0.164	0.049	0.005	0.003	0	0.013	16
2003	234	0	47	1532.237	-116.121	D	0.224	20.96	21.184	1.07	3.7	0.208	0.01	0.001	0.001	0	0.004	17
2003	300	0	47	1532.237	-116.121	D	0.204	20.96	21.164	0.97	3.2	0.145	0.034	0.004	0.004	0	0.018	18
2003	126	0	11	1531.512	-120.021	D	0.194	20.96	21.154	0.93	3	0.135	0.046	0.003	0.002	0	0.008	19
2003	169	0	1	1528.821	-121.486	D	0.193	20.96	21.153	0.92	3.3	0.16	0.03	0.001	0	0	0.002	20
2003	146	0	40	1532.414	-117.026	D	0.186	20.96	21.146	0.89	3	0.169	0.01	0.002	0.001	0	0.005	21
2003	308	0	11	1531.512	-120.021	D	0.172	20.96	21.132	0.82	2.8	0.158	0.005	0.002	0.001	0	0.006	22

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
7.85	7.40	0.45
7.83	7.40	0.43
7.81	7.40	0.41
7.78	7.40	0.38
7.76	7.40	0.36
7.68	7.40	0.28
7.62	7.40	0.22
7.60	7.40	0.20
7.57	7.40	0.17
7.56	7.40	0.16
7.53	7.40	0.13
7.53	7.40	0.13
7.53	7.40	0.13
7.52	7.40	0.12
7.51	7.40	0.11
7.51	7.40	0.11
7.51	7.40	0.11
7.50	7.40	0.10
7.49	7.40	0.09
7.49	7.40	0.09
7.49	7.40	0.09
7.48	7.40	0.08

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

11
0.02

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

6. Enter desired NO₂/NOx ratio (default is 0)

--

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Source	BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	New Rank	dv(total)	dv(bkg)	Δdv	
											bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	New Rank	dv(total)	dv(bkg)	Δdv	
2003	71	0	11	1531.512	-120.021	D	0.770	21.26	22.038	3.65	78	0.391	0.289	0.019	0.012	0.001	0.059	0	1	7.90	7.54	0.36
2003	299	0	40	1532.414	-117.026	D	0.717	21.67	22.388	3.34	83	0.513	0.129	0.017	0.009	0.001	0.048	0	2	8.06	7.73	0.33
2003	345	0	3	1530.255	-121.206	D	0.687	21.67	22.357	3.20	83	0.404	0.222	0.009	0.009	0	0.043	0	3	8.05	7.73	0.31
2003	233	0	3	1530.255	-121.206	D	0.655	22.21	22.875	2.97	87	0.62	0.013	0.005	0.003	0	0.015	0	4	8.27	7.98	0.29
2003	323	0	1	1528.821	-121.486	D	0.590	21.33	21.925	2.79	79	0.426	0.125	0.009	0.005	0	0.026	0	5	7.85	7.58	0.28
2003	283	0	2	1529.538	-121.346	D	0.468	21.67	22.136	2.18	83	0.313	0.117	0.008	0.005	0	0.025	0	6	7.95	7.73	0.22
2003	170	0	11	1531.512	-120.021	D	0.371	21.78	22.154	1.72	84	0.305	0.053	0.003	0.001	0	0.008	0	7	7.95	7.78	0.17
2003	38	0	40	1532.414	-117.026	D	0.333	21.14	21.478	1.59	76	0.179	0.123	0.006	0.004	0	0.02	0	8	7.64	7.49	0.16
2003	266	0	47	1532.237	-116.121	D	0.299	22.21	22.516	1.36	87	0.197	0.062	0.009	0.005	0	0.026	0	9	8.12	7.98	0.13
2003	282	0	40	1532.414	-117.026	D	0.263	21.67	21.930	1.23	83	0.224	0.021	0.004	0.002	0	0.012	0	10	7.85	7.73	0.12
2003	64	0	11	1531.512	-120.021	D	0.229	21.26	21.492	1.08	78	0.104	0.093	0.006	0.004	0	0.021	0	11	7.65	7.54	0.11
2003	88	0	1	1528.821	-121.486	D	0.217	21.26	21.480	1.03	78	0.155	0.032	0.006	0.004	0	0.019	0	12	7.65	7.54	0.10
2003	4	0	1	1528.821	-121.486	D	0.218	21.33	21.550	1.03	79	0.118	0.08	0.004	0.003	0	0.013	0	13	7.68	7.58	0.10
2003	147	0	40	1532.414	-117.026	D	0.195	21.48	21.673	0.91	81	0.159	0.028	0.002	0.001	0	0.006	0	14	7.73	7.64	0.09
2003	144	0	2	1529.538	-121.346	D	0.180	21.48	21.658	0.84	81	0.109	0.07	0	0	0	0.001	0	16	7.73	7.64	0.08
2003	75	0	11	1531.512	-120.021	D	0.184	21.26	21.446	0.87	78	0.124	0.04	0.004	0.003	0	0.013	0	15	7.63	7.54	0.09
2003	234	0	47	1532.237	-116.121	D	0.180	22.21	22.396	0.82	87	0.165	0.009	8E-04	0.001	0	0.004	0	17	8.06	7.98	0.08
2003	300	0	47	1532.237	-116.121	D	0.163	21.67	21.829	0.76	83	0.11	0.028	0.003	0.004	0	0.018	0	18	7.81	7.73	0.08
2003	126	0	11	1531.512	-120.021	D	0.151	21.48	21.628	0.71	81	0.101	0.037	0.002	0.002	0	0.008	0	19	7.71	7.64	0.07
2003	169	0	1	1528.821	-121.486	D	0.150	21.78	21.932	0.70	84	0.123	0.025	8E-04	0	0	0.002	0	20	7.85	7.78	0.07
2003	146	0	40	1532.414	-117.026	D	0.142	21.48	21.620	0.67	81	0.126	0.008	0.002	0.001	0	0.005	0	21	7.71	7.64	0.07
2003	308	0	11	1531.512	-120.021	D	0.131	21.3														

Ranked Daily Visibility Change for Shenandoah (Top 20 Days for 2001 – New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank
2001	247	0	55	1574.426	-56.014 D	0.789	20.98	21.769	3.76	3.9	0.744	0.007	0.009	0.005	0	0.024	1
2001	329	0	343	1610.98	38.106 D	0.758	20.98	21.738	3.61	3	0.531	0.169	0.014	0.007	0	0.037	2
2001	334	0	340	1611.36	36.303 D	0.732	20.98	21.712	3.49	3	0.56	0.138	0.007	0.005	0	0.023	3
2001	343	0	53	1570.525	-58.686 D	0.706	20.98	21.686	3.37	3.4	0.56	0.118	0.007	0.004	0	0.018	4
2001	179	0	166	1593.976	-14.384 D	0.706	20.98	21.686	3.37	3.4	0.612	0.057	0.009	0.005	0	0.023	5
2001	138	0	55	1574.426	-56.014 D	0.701	20.98	21.681	3.34	3.1	0.554	0.125	0.006	0.003	0	0.014	6
2001	103	0	55	1574.426	-56.014 D	0.68	20.98	21.66	3.24	2.5	0.56	0.088	0.008	0.004	0	0.019	7
2001	205	0	53	1570.525	-58.686 D	0.663	20.98	21.643	3.16	3.5	0.619	0.011	0.008	0.004	0	0.02	8
2001	253	0	310	1611.47	28.794 D	0.63	20.98	21.61	3	3.9	0.534	0.05	0.012	0.006	0	0.028	9
2001	36	0	336	1611.739	34.5 D	0.583	20.98	21.563	2.78	2.8	0.39	0.13	0.013	0.008	0	0.041	10
2001	129	0	55	1574.426	-56.014 D	0.46	20.98	21.44	2.19	3.1	0.39	0.043	0.007	0.003	0	0.017	11
2001	153	0	336	1611.739	34.5 D	0.37	20.98	21.35	1.76	3.4	0.315	0.028	0.006	0.003	0	0.017	12
2001	215	0	168	1587.946	-13.746 D	0.358	20.98	21.338	1.71	3.9	0.315	0.031	0.003	0.001	0	0.007	13
2001	214	0	60	1576.167	-50.018 D	0.336	20.98	21.316	1.6	3.9	0.309	0.01	0.004	0.002	0	0.01	14
2001	252	0	336	1611.739	34.5 D	0.335	20.98	21.315	1.59	3.9	0.297	0.026	0.003	0.002	0	0.008	15
2001	142	0	219	1605.108	2.985 D	0.33	20.98	21.31	1.57	3.1	0.266	0.054	0.002	0.001	0	0.006	16
2001	348	0	55	1574.426	-56.014 D	0.32	20.98	21.3	1.52	3.4	0.247	0.064	0.002	0.001	0	0.005	17
2001	263	0	343	1610.98	38.106 D	0.313	20.98	21.293	1.49	3.9	0.297	0.003	0.003	0.002	0	0.008	18
2001	306	0	182	1602.75	-6.918 D	0.303	20.98	21.283	1.44	3	0.221	0.061	0.005	0.002	0	0.013	19
2001	146	0	349	1608.439	43.221 D	0.299	20.98	21.279	1.42	3.1	0.235	0.022	0.001	0.005	0	0.027	20
2001	72	0	141	1589.804	-22.771 D	0.294	20.98	21.274	1.4	2.8	0.213	0.045	0.009	0.004	0	0.022	21
2001	332	0	227	1606.142	5.084 D	0.285	20.98	21.265	1.36	3	0.259	0.013	0.003	0.002	0	0.008	22

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
7.78	7.41	0.37
7.76	7.41	0.35
7.75	7.41	0.34
7.74	7.41	0.33
7.74	7.41	0.33
7.74	7.41	0.33
7.73	7.41	0.32
7.72	7.41	0.31
7.71	7.41	0.30
7.68	7.41	0.27
7.63	7.41	0.22
7.58	7.41	0.17
7.58	7.41	0.17
7.57	7.41	0.16
7.57	7.41	0.16
7.57	7.41	0.16
7.56	7.41	0.15
7.56	7.41	0.15
7.55	7.41	0.14
7.55	7.41	0.14
7.54	7.41	0.13

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

10
0.02

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

6. Enter desired NO₂/NOx ratio (default is 0)

--

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	Source BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	Rank	New			
																		dv(total)	dv(bkg)	Δdv	
2001	247	0	55	1574.426	-56.014 D	0.639	21.41	22.050	3.01	88	0.597	0.006	0.007	0.005	0	0.024	0	1	7.91	7.61	0.30
2001	329	0	343	1610.98	38.106 D	0.590	20.48	21.071	2.90	81	0.398	0.137	0.011	0.007	0	0.037	0	2	7.45	7.17	0.29
2001	334	0	340	1611.36	36.303 D	0.565	20.48	21.046	2.78	81	0.419	0.112	0.005	0.005	0	0.023	0	3	7.44	7.17	0.27
2001	343	0	53	1570.525	-58.686 D	0.564	20.90	21.471	2.72	85	0.437	0.1	0.005	0.004	0	0.018	0	4	7.64	7.37	0.27
2001	179	0	166	1593.976	-14.384 D	0.561	20.90	21.468	2.70	85	0.477	0.048	0.007	0.005	0	0.023	0	5	7.64	7.37	0.27
2001	138	0	55	1574.426	-56.014 D	0.541	20.57	21.116	2.65	82	0.417	0.102	0.005	0.003	0	0.014	0	6	7.47	7.21	0.26
2001	103	0	55	1574.426	-56.014 D	0.524	20.10	20.624	2.63	75	0.423	0.072	0.006	0.004	0	0.019	0	7	7.24	6.98	0.26
2001	205	0	53	1570.525	-58.686 D	0.532	21.04	21.579	2.55	86	0.492	0.009	0.006	0.004	0	0.02	0	8	7.69	7.44	0.25
2001	253	0	310	1611.47	28.794 D	0.515	21.41	21.925	2.43	88	0.428	0.044	0.009	0.006	0	0.028	0	9	7.85	7.61	0.24
2001	36	0	336	1611.739	34.5 D	0.458	20.33	20.792	2.27	79	0.293	0.106	0.001	0.008	0	0.041	0	10	7.32	7.10	0.22
2001	129	0	55	1574.426	-56.014 D	0.354	20.57	20.928	1.74	82	0.294	0.035	0.005	0.003	0	0.017	0	11	7.38	7.21	0.17
2001	153	0	336	1611.739	34.5 D	0.294	20.90	21.199	1.42	85	0.245	0.024	0.005	0.003	0	0.017	0	12	7.51	7.37	0.14
2001	215	0	168	1587.946	-13.746 D	0.290	21.41	21.697	1.36	88	0.253	0.027	0.002	0.001	0	0.007	0	13	7.75	7.61	0.14
2001	214	0	60	1576.167	-50.018 D	0.272	21.41	21.679	1.28	88	0.248	0.009	0.003	0.002	0	0.001	0	15	7.74	7.61	0.13
2001	252	0	336	1611.739	34.5 D	0.273	21.41	21.680	1.29	88	0.238	0.023	0.002	0.002	0	0.008	0	14	7.74	7.61	0.13
2001	142	0	219	1605.108	2.985 D	0.253	20.57	20.825	1.24	82	0.2	0.044	0.002	0.001	0	0.006	0	16	7.34	7.21	0.12
2001	348	0	55	1574.426	-56.014 D	0.254	20.90	21.158	1.22	85	0.192	0.054	0.002	0.001	0	0.005	0	17	7.49	7.37	0.12
2001	263	0	343	1610.98	38.106 D	0.253	21.41	21.660	1.19	88	0.238	0.003	0.002	0.002	0	0.008	0	18	7.73	7.61	0.12
2001	306	0	182	1602.75	-6.918 D	0.234	20.48	20.712	1.15	81	0.165	0.049	0.004	0.002	0	0.013	0	20	7.28	7.17	0.11
2001	146	0	349	1608.439	43.221 D	0.234	20.57	20.807	1.15	82	0.177	0.018	0.008	0.005	0	0.027	0	19	7.33	7.21	0.11
2001	72	0	141	1589.804	-22.771 D	0.230	20.33	20.562	1.14	79	0.16	0.037	0.007	0.004	0	0.022	0	21	7.21	7.10	0.11
2001	332	0	227	1606.142	5.084 D	0.217	20.48	20.695	1.07	81	0.194	0.011	0.002	0.002	0	0.008	0	22	7.27	7.17	0.11

Ranked Daily Visibility Change for Shenandoah (Top 20 Days for 2002 – New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank
2002	42	0	68	1576.853	-46.117 D	1.455	20.98	22.435	6.94	2.8	0.922	0.462	0.019	0.009	0.001	0.043	1
2002	263	0	310	1611.47	28.794 D	0.895	20.98	21.875	4.27	3.9	0.809	0.024	0.015	0.007	0.001	0.038	2
2002	150	0	182	1602.75	-6.918 D	0.719	20.98	21.699	3.43	3.1	0.532	0.136	0.014	0.006	0.001	0.03	3
2002	151	0	182	1602.75	-6.918 D	0.711	20.98	21.691	3.39	3.1	0.581	0.077	0.013	0.006	0.001	0.032	4
2002	278	0	227	1606.142	5.084 D	0.666	20.98	21.646	3.18	3.2	0.625	0.001	0.01	0.005	0	0.025	5
2002	104	0	227	1606.142	5.084 D	0.631	20.98	21.611	3.01	2.5	0.45	0.123	0.014	0.007	0	0.036	6
2002	171	0	227	1606.142	5.084 D	0.63	20.98	21.61	3	3.4	0.535	0.064	0.008	0	0.019	7	
2002	326	0	336	1611.739	34.5 D	0.581	20.98	21.561	2.77	3	0.416	0.132	0.007	0.004	0	0.021	8
2002	86	0	219	1605.108	2.985 D	0.573	20.98	21.553	2.73	2.8	0.379	0.158	0.009	0.004	0	0.022	9
2002	195	0	103	1583.156	-33.543 D	0.533	20.98	21.513	2.54	3.5	0.491	0.018	0.006	0.003	0	0.015	10
2002	354	0	182	1602.75	-6.918 D	0.531	20.98	21.511	2.53	3.4	0.33	0.156	0.011	0.005	0	0.028	11
2002	62	0	336	1611.739	34.5 D	0.515	20.98	21.495	2.45	2.8	0.259	0.193	0.013	0.008	0.001	0.041	12
2002	271	0	310	1611.47	28.794 D	0.435	20.98	21.415	2.07	3.9	0.274	0.152	0.002	0.001	0	0.006	13
2002	204	0	55	1574.426	-56.014 D	0.397	20.98	21.377	1.89	3.5	0.382	0.002	0.003	0.002	0	0.008	14
2002	130	0	55	1574.426	-56.014 D	0.388	20.98	21.368	1.85	3.1	0.29	0.078	0.006	0.002	0	0.012	15
2002	73	0	182	1602.75	-6.918 D	0.312	20.98	21.292	1.49	2.8	0.245	0.054	0.003	0.002	0	0.008	16
2002	365	0	310	1611.47	28.794 D	0.288	20.98	21.268	1.37	3.4	0.139	0.129	0.005	0.002	0	0.012	17
2002	152	0	55	1574.426	-56.014 D	0.278	20.98	21.258	1.33	3.1	0.225	0.036	0.004	0.002	0	0.011	18
2002	216	0	53	1570.525	-58.686 D	0.257	20.98	21.237	1.22	3.9	0.247	0.001	0.002	0.001	0	0.005	19
2002	275	0	182	1602.75	-6.918 D	0.25	20.98	21.23	1.19	3.2	0.192	0.045	0.003	0.001	0	0.007	20
2002	175	0	148	1592.264	-20.383 D	0.247	20.98	21.227	1.18	3.4	0.229	0.005	0.003	0.002	0	0.008	21
2002	262	0	55	1574.426	-56.014 D	0.243	20.98	21.223	1.16	3.9	0.233	0.001	0.002	0.001	0	0.006	22

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

10
0.02

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Adv
8.08	7.41	0.67
7.83	7.41	0.42
7.75	7.41	0.34
7.74	7.41	0.33
7.72	7.41	0.31
7.71	7.41	0.30
7.71	7.41	0.30
7.68	7.41	0.27
7.68	7.41	0.27
7.66	7.41	0.25
7.66	7.41	0.25
7.65	7.41	0.24
7.62	7.41	0.21
7.60	7.41	0.19
7.59	7.41	0.18
7.56	7.41	0.15
7.55	7.41	0.14
7.54	7.41	0.13
7.53	7.41	0.12
7.53	7.41	0.12
7.53	7.41	0.12
7.53	7.41	0.12

6. Enter desired NO₂/NO_x ratio (default is 0)

--

OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Source	BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	New	dv(total)
2002	42	0	68	1576.853	-46.117 D	1.140	20.33	21.479	5.65	79	0.695	0.377	0.015	0.009	0.001	0.043	0	1	7.64
2002	263	0	310	1611.47	28.794 D	0.728	21.41	22.139	3.43	88	0.65	0.021	0.012	0.007	0.001	0.038	0	2	7.95
2002	150	0	182	1602.75	-6.918 D	0.560	20.57	21.135	2.74	82	0.401	0.111	0.011	0.006	0.001	0.03	0	3	7.48
2002	151	0	182	1602.75	-6.918 D	0.550	20.57	21.125	2.70	82	0.438	0.063	0.01	0.006	0.001	0.032	0	4	7.48
2002	278	0	227	1606.142	5.084 D	0.512	20.67	21.182	2.50	83	0.473	0.084	0.008	0.005	0	0.025	0	5	7.51
2002	104	0	227	1606.142	5.084 D	0.494	20.10	20.593	2.48	75	0.339	0.1	0.011	0.007	0	0.036	0	6	7.22
2002	171	0	227	1606.142	5.084 D	0.500	20.90	21.407	2.41	85	0.417	0.054	0.006	0.004	0	0.019	0	7	7.61
2002	326	0	336	1611.739	34.5 D	0.449	20.48	20.929	2.21	81	0.311	0.107	0.005	0.004	0	0.021	0	9	7.39
2002	86	0	219	1605.108	2.985 D	0.447	20.33	20.781	2.22	79	0.285	0.129	0.007	0.004	0	0.022	0	8	7.31
2002	195	0	103	1583.156	-33.543 D	0.429	21.04	21.475	2.05	86	0.39	0.016	0.005	0.003	0	0.015	0	11	7.64
2002	354	0	182	1602.75	-6.918 D	0.431	20.90	21.336	2.08	85	0.257	0.132	0.009	0.005	0	0.028	0	10	7.58
2002	62	0	336	1611.739	34.5 D	0.412	20.33	20.746	2.04	79	0.195	0.157	0.01	0.008	0.001	0.041	0	12	7.30
2002	271	0	310	1611.47	28.794 D	0.361	21.41	21.768	1.69	88	0.22	0.132	0.002	0.001	0	0.006	0	13	7.78
2002	204	0	55	1574.426	-56.014 D	0.318	21.04	21.363	1.52	86	0.304	0.002	0.002	0	0.008	0	14	7.59	
2002	130	0	55	1574.426	-56.014 D	0.300	20.57	20.873	1.47	82	0.218	0.064	0.005	0.002	0	0.012	0	15	7.36
2002	73	0	182	1602.75	-6.918 D	0.240	20.33	20.573	1.19	79	0.184	0.044	0.002	0.002	0	0.008	0	16	7.21
2002	365	0	310	1611.47	28.794 D	0.235	20.90	21.139	1.13	85	0.108	0.109	0.004	0.002	0	0.012	0	17	7.49
2002	152	0	55	1574.426	-56.014 D	0.215	20.57	20.787	1.05	82	0.169	0.029	0.003	0.002	0	0.011	0	18	7.32
2002	216	0	53	1570.525	-58.686 D	0.206	21.41	21.613	0.97	88	0.198	9E-04	0.002	0.001	0	0.005	0	19	7.71
2002	275	0	182	1602.75	-6.918 D	0.192	20.67	20.859	0.94	83	0.145	0.037	0.002	0.001	0	0.007	0	21	7.35
2002	175	0	148	1592.264	-20.383 D	0.195	20.90	21.099	0.94	85	0.178	0.004	0.002	0	0.008	0	20	7.47	
2002	262	0	55	1574.426	-56.014 D	0.196	21.41	21.603	0.92	88	0.187	9E-04	0.002	0.001	0	0.006	0	22	7.61

Ranked Daily Visibility Change for Shenandoah (Top 20 Days for 2003 – New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank
2003	258	0	310	1611.47	28.794 D	3.174	20.98	24.154	15.13	3.9	2.845	0.19	0.034	0.017	0.002	0.086	1
2003	328	0	148	1592.264	-20.383 D	2.254	20.98	23.234	10.74	3	1.756	0.357	0.038	0.016	0.001	0.085	2
2003	345	0	103	1583.156	-33.543 D	1.648	20.98	22.628	7.86	3.4	0.752	0.794	0.033	0.01	0.002	0.057	3
2003	299	0	53	1570.525	-58.686 D	1.156	20.98	22.136	5.51	3.2	0.884	0.19	0.026	0.009	0.001	0.047	4
2003	344	0	336	1611.739	34.5 D	0.776	20.98	21.756	3.7	3.4	0.492	0.24	0.011	0.005	0	0.027	5
2003	71	0	53	1570.525	-58.686 D	0.725	20.98	21.705	3.46	2.8	0.467	0.202	0.015	0.007	0	0.034	6
2003	136	0	336	1611.739	34.5 D	0.551	20.98	21.531	2.63	3.1	0.479	0.041	0.008	0.004	0	0.019	7
2003	234	0	182	1602.75	-6.918 D	0.537	20.98	21.517	2.56	3.9	0.515	0.01	0.003	0.002	0	0.008	8
2003	281	0	182	1602.75	-6.918 D	0.535	20.98	21.515	2.55	3.2	0.473	0.039	0.006	0.003	0	0.014	9
2003	38	0	53	1570.525	-58.686 D	0.527	20.98	21.507	2.51	2.8	0.298	0.203	0.009	0.003	0	0.015	10
2003	61	0	336	1611.739	34.5 D	0.456	20.98	21.436	2.17	2.8	0.345	0.09	0.005	0.003	0	0.013	11
2003	170	0	55	1574.426	-56.014 D	0.45	20.98	21.43	2.15	3.4	0.418	0.022	0.003	0.001	0	0.006	12
2003	233	0	53	1570.525	-58.686 D	0.42	20.98	21.4	2	3.9	0.404	0.005	0.003	0.001	0	0.007	13
2003	300	0	182	1602.75	-6.918 D	0.393	20.98	21.373	1.87	3.2	0.299	0.066	0.007	0.003	0	0.018	14
2003	39	0	74	1571.858	-43.371 D	0.382	20.98	21.362	1.82	2.8	0.237	0.124	0.005	0.003	0	0.013	15
2003	266	0	55	1574.426	-56.014 D	0.331	20.98	21.311	1.58	3.9	0.267	0.04	0.006	0.003	0	0.014	16
2003	75	0	55	1574.426	-56.014 D	0.327	20.98	21.307	1.56	2.8	0.263	0.035	0.008	0.003	0	0.018	17
2003	329	0	349	1608.439	43.221 D	0.323	20.98	21.303	1.54	3	0.186	0.104	0.008	0.004	0	0.021	18
2003	64	0	182	1602.75	-6.918 D	0.3	20.98	21.28	1.43	2.8	0.194	0.082	0.006	0.003	0	0.015	19
2003	323	0	53	1570.525	-58.686 D	0.296	20.98	21.276	1.41	3	0.203	0.071	0.005	0.003	0	0.014	20
2003	126	0	310	1611.47	28.794 D	0.285	20.98	21.265	1.36	3.1	0.203	0.068	0.003	0.002	0	0.009	21
2003	62	0	343	1610.98	38.106 D	0.282	20.98	21.262	1.35	2.8	0.194	0.072	0.004	0.002	0	0.01	22

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
8.82	7.41	1.41
8.43	7.41	1.02
8.17	7.41	0.76
7.95	7.41	0.54
7.77	7.41	0.36
7.75	7.41	0.34
7.67	7.41	0.26
7.66	7.41	0.25
7.66	7.41	0.25
7.66	7.41	0.25
7.62	7.41	0.22
7.62	7.41	0.21
7.61	7.41	0.20
7.60	7.41	0.19
7.59	7.41	0.18
7.57	7.41	0.16
7.56	7.41	0.15
7.56	7.41	0.15
7.55	7.41	0.14
7.55	7.41	0.14
7.54	7.41	0.13
7.54	7.41	0.13

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

10
0.02

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

6. Enter desired NO₂/NOx ratio (default is 0)

--

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	Source BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO ₂	Rank	New	dv(total)	dv(bkg)	Δdv
																		dv(total)	dv(bkg)	Δdv	
2003	258	0	310	1611.47	28.794 D	2.593	21.41	24.018	12.21	88	2.297	0.165	0.026	0.017	0.002	0.086	0	1	8.76	7.61	1.15
2003	328	0	148	1592.264	-20.383 D	1.743	20.48	22.235	8.59	81	1.322	0.29	0.029	0.016	0.001	0.085	0	2	7.99	7.17	0.82
2003	345	0	103	1583.156	-33.543 D	1.354	20.90	22.266	6.52	85	0.587	0.673	0.026	0.01	0.002	0.057	0	3	8.00	7.37	0.63
2003	299	0	53	1570.525	-58.686 D	0.903	20.67	21.576	4.41	83	0.67	0.156	0.02	0.009	0.001	0.047	0	4	7.69	7.26	0.43
2003	344	0	336	1611.739	34.5 D	0.627	20.90	21.534	3.02	85	0.384	0.203	0.009	0.005	0	0.027	0	5	7.67	7.37	0.30
2003	71	0	53	1570.525	-58.686 D	0.569	20.33	20.904	2.82	79	0.351	0.165	0.012	0.007	0	0.034	0	6	7.37	7.10	0.28
2003	136	0	336	1611.739	34.5 D	0.423	20.57	20.997	2.08	82	0.361	0.033	0.006	0.004	0	0.019	0	7	7.42	7.21	0.21
2003	234	0	182	1602.75	-6.918 D	0.434	21.41	21.843	2.04	88	0.413	0.009	0.002	0.002	0	0.008	0	9	7.81	7.61	0.20
2003	281	0	182	1602.75	-6.918 D	0.412	20.67	21.080	2.01	83	0.358	0.032	0.005	0.003	0	0.014	0	10	7.46	7.26	0.20
2003	38	0	53	1570.525	-58.686 D	0.414	20.33	20.748	2.05	79	0.224	0.165	0.007	0.003	0	0.015	0	8	7.30	7.10	0.20
2003	61	0	336	1611.739	34.5 D	0.353	20.33	20.686	1.75	79	0.259	0.073	0.004	0.003	0	0.013	0	11	7.27	7.10	0.17
2003	170	0	55	1574.426	-56.014 D	0.354	20.90	21.259	1.71	85	0.326	0.019	0.002	0.001	0	0.006	0	12	7.54	7.37	0.17
2003	233	0	53	1570.525	-58.686 D	0.339	21.41	21.747	1.59	88	0.324	0.004	0.002	0.001	0	0.007	0	13	7.77	7.61	0.16
2003	300	0	182	1602.75	-6.918 D	0.307	20.67	20.974	1.50	83	0.226	0.054	0.005	0.003	0	0.018	0	14	7.41	7.26	0.15
2003	39	0	74	1571.858	-43.371 D	0.299	20.33	20.632	1.48	79	0.178	0.101	0.004	0.003	0	0.013	0	15	7.24	7.10	0.15
2003	266	0	55	1574.426	-56.014 D	0.271	21.41	21.678	1.27	88	0.214	0.035	0.005	0.003	0	0.014	0	16	7.74	7.61	0.13
2003	75	0	55	1574.426	-56.014 D	0.253	20.33	20.586	1.26	79	0.198	0.029	0.006	0.003	0	0.018	0	17	7.22	7.10	0.13
2003	329	0	349	1608.439	43.221 D	0.255	20.48	20.733	1.25	81	0.139	0.084	0.006	0.004	0	0.021	0	18	7.29	7.17	0.12
2003	64	0	182	1602.75	-6.918 D	0.235	20.33	20.567	1.17	79	0.146	0.067	0.005	0.003	0	0.015	0	19	7.21	7.10	0.12
2003	323	0	53	1570.525	-58.686 D	0.230	20.48	20.709	1.13	81	0.152	0.058	0.004	0.003	0	0.014	0	20	7.28	7.17	0.11
2003	126	0	310	1611.47	28.794 D	0.221	20.57	20.794	1.09	82	0.153	0.055	0.002	0.002	0	0.009	0	22	7.32	7.21	0.11
2003	62	0	343	1610.98	38.106 D	0.219	20.33	20.552	1.09	79	0.146	0.059	0.003	0.002	0	0.01	0	21	7.20	7.10	0.11

</div

Ranked Daily Visibility Change for Swanquarter (Top 20 Days for 2001– New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

- 1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)**

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank	
2001	191	0	401	1859.118	-296.976	D	2.386	20.92	23.306	11.41	3.4	2.263	0.008	0.028	0.014	0.001	0.072	1
2001	197	0	364	1864.565	-300.448	D	1.986	20.92	22.906	9.49	3.4	1.849	0.012	0.032	0.015	0.002	0.077	2
2001	360	0	402	1859.851	-296.805	D	1.265	20.92	22.185	6.05	3.1	0.775	0.365	0.035	0.014	0.002	0.074	3
2001	131	0	373	1860.688	-300.402	D	0.928	20.92	21.848	4.44	2.9	0.852	0.005	0.016	0.009	0	0.045	4
2001	361	0	388	1843.4	-302.509	D	0.926	20.92	21.846	4.43	3.1	0.577	0.263	0.021	0.011	0.001	0.054	5
2001	262	0	402	1859.851	-296.805	D	0.889	20.92	21.809	4.25	3.4	0.788	0.059	0.01	0.005	0.001	0.026	6
2001	29	0	388	1843.4	-302.509	D	0.761	20.92	21.681	3.64	2.9	0.469	0.194	0.022	0.013	0.001	0.063	7
2001	78	0	388	1843.4	-302.509	D	0.713	20.92	21.633	3.41	2.6	0.438	0.145	0.032	0.016	0.001	0.082	8
2001	236	0	388	1843.4	-302.509	D	0.688	20.92	21.608	3.29	3.5	0.647	0.016	0.006	0.003	0	0.016	9
2001	169	0	388	1843.4	-302.509	D	0.672	20.92	21.592	3.21	3.2	0.565	0.012	0.025	0.011	0.001	0.058	10
2001	17	0	377	1863.622	-299.719	D	0.671	20.92	21.591	3.21	2.9	0.483	0.125	0.015	0.008	0.001	0.039	11
2001	304	0	388	1843.4	-302.509	D	0.65	20.92	21.57	3.1	3.1	0.467	0.121	0.016	0.007	0.001	0.038	12
2001	18	0	351	1857.33	-305.922	D	0.636	20.92	21.556	3.04	2.9	0.411	0.175	0.012	0.006	0.001	0.031	13
2001	270	0	397	1848.327	-300.425	D	0.625	20.92	21.545	2.99	3.4	0.505	0.044	0.02	0.009	0.001	0.045	14
2001	337	0	398	1856.394	-298.556	D	0.624	20.92	21.544	2.98	3.1	0.489	0.069	0.016	0.008	0.001	0.041	15
2001	261	0	388	1843.4	-302.509	D	0.592	20.92	21.512	2.83	3.4	0.524	0.033	0.008	0.004	0	0.022	16
2001	256	0	388	1843.4	-302.509	D	0.593	20.92	21.513	2.83	3.4	0.432	0.058	0.027	0.012	0.002	0.062	17
2001	3	0	397	1848.327	-300.425	D	0.55	20.92	21.47	2.63	2.9	0.276	0.185	0.022	0.011	0.001	0.055	18
2001	192	0	357	1844.755	-305.04	D	0.548	20.92	21.468	2.62	3.4	0.513	0.014	0.005	0.003	0	0.013	19
2001	170	0	357	1844.755	-305.04	D	0.534	20.92	21.454	2.55	3.2	0.439	0.025	0.018	0.008	0.001	0.043	20
2001	144	0	357	1844.755	-305.04	D	0.523	20.92	21.443	2.5	2.9	0.468	0.007	0.012	0.006	0	0.03	21
2001	35	0	388	1843.4	-302.509	D	0.522	20.92	21.442	2.5	2.7	0.314	0.155	0.013	0.006	0	0.033	22

- 5. Check calculated values below against CALPOST's "Ranked Daily Visibility"**

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
8.46	7.38	1.08
8.29	7.38	0.91
7.97	7.38	0.59
7.82	7.38	0.43
7.81	7.38	0.43
7.80	7.38	0.42
7.74	7.38	0.36
7.72	7.38	0.34
7.70	7.38	0.32
7.70	7.38	0.32
7.70	7.38	0.32
7.69	7.38	0.31
7.68	7.38	0.30
7.68	7.38	0.29
7.68	7.38	0.29
7.66	7.38	0.28
7.66	7.38	0.28
7.64	7.38	0.26
7.64	7.38	0.26
7.63	7.38	0.25
7.63	7.38	0.25

- 3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet**

12

- 4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.**

0.13

- 6. Enter desired NO₂/NOx ratio (default is 0)**

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Source	BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	New Rank	dv(total)	dv(bkg)	Δdv	
											bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	New Rank	dv(total)	dv(bkg)	Δdv	
2001	191	0	401	1859.118	-296.976	D	1.890	23.67	25.578	8.05	85	1.775	0.007	0.022	0.014	0.001	0.072	0	1	9.39	8.62	0.77
2001	197	0	364	1864.565	-300.448	D	1.577	23.67	25.262	6.72	85	1.448	0.01	0.025	0.015	0.002	0.077	0	2	9.27	8.62	0.65
2001	360	0	402	1859.851	-296.805	D	1.000	23.28	24.291	4.33	82	0.584	0.298	0.027	0.014	0.002	0.074	0	3	8.88	8.45	0.42
2001	131	0	373	1860.688	-300.402	D	0.710	23.08	23.795	3.11	80	0.639	0.004	0.012	0.009	0	0.045	0	5	8.67	8.36	0.31
2001	361	0	388	1843.4	-302.509	D	0.732	23.28	24.020	3.17	82	0.435	0.215	0.016	0.011	0.001	0.054	0	4	8.76	8.45	0.31
2001	262	0	402	1859.851	-296.805	D	0.705	23.67	24.381	3.00	85	0.615	0.05	0.008	0.005	0.001	0.026	0	6	8.91	8.62	0.30
2001	29	0	388	1843.4	-302.509	D	0.603	23.08	23.687	2.64	80	0.351	0.158	0.017	0.013	0.001	0.063	0	7	8.62	8.36	0.26
2001	78	0	388	1843.4	-302.509	D	0.565	22.77	23.341	2.51	76	0.325	0.117	0.025	0.016	0.001	0.082	0	8	8.48	8.23	0.25
2001	236	0	388	1843.4	-302.509	D	0.552	23.84	24.400	2.33	86	0.515	0.014	0.005	0.003	0	0.016	0	9	8.92	8.69	0.23
2001	169	0	388	1843.4	-302.509	D	0.527	23.40	23.936	2.28	83	0.428	0.01	0.019	0.011	0.001	0.058	0	11	8.73	8.50	0.23
2001	17	0	377	1863.622	-299.719	D	0.523	23.08	23.606	2.29	80	0.362	0.101	0.012	0.008	0.001	0.039	0	10	8.59	8.36	0.23
2001	304	0	388	1843.4	-302.509	D	0.509	23.28	23.796	2.20	82	0.352	0.099	0.012	0.007	0.001	0.038	0	12	8.67	8.45	0.22
2001	18	0	351	1857.33	-305.922	D	0.497	23.08	23.580	2.17	80	0.308	0.142	0.009	0.006	0.001	0.031	0	13	8.58	8.36	0.21
2001	270	0	397	1848.327	-300.425	D	0.501	23.67	24.177	2.14	85	0.394	0.037	0.015	0.009	0.001	0.045	0	14	8.83	8.62	0.21
2001	337	0	398	1856.394	-298.556	D	0.487	23.28	23.774	2.11	82	0.368	0.056	0.012	0.008	0.001	0.041	0	15	8.66	8.45	0.21
2001	261	0	388	1843.4	-302.509	D	0.469	23.67	24.144	2.00	85	0.409	0.028	0.006	0.004	0	0.022	0	17	8.81	8.62	0.20
2001	256	0	388	1843.4	-302.509	D	0.483	23.67	24.159	2.06	85	0.337	0.049	0.021	0.012	0.002	0.062	0	16	8.82	8.62	0.20
2001	3	0	397	1848.327	-300.425	D	0.441	23.08	23.523	1.93	80	0.207	0.15	0.017	0.011	0.001	0.055	0	18	8.55	8.36	0.19
2001	192	0	357	1844.755	-305.04	D	0.432	23.67	24.106	1.84	85	0.4	0.012	0.004	0.003	0	0.013	0	19	8.80	8.62	0.18
2001	170	0	357	1844.755	-305.04	D	0.419	23.40	23.827	1.81	83	0.332	0.021	0.014	0.008	0.001	0.043	0	21	8.68	8.50	0.18
2001	144	0	357	1844.755	-305.04	D	0.402	23.08	23.484	1.76	80	0.351	0.006	0.009	0.006	0	0					

Ranked Daily Visibility Change for Swanquarter (Top 20 Days for 2002– New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank	
2002	246	0	388	1843.4	-302.509	D	2.589	20.92	23.509	12.38	3.4	2.197	0.143	0.063	0.03	0.004	0.152	1
2002	304	0	388	1843.4	-302.509	D	1.987	20.92	22.907	9.5	3.1	1.506	0.379	0.023	0.013	0.001	0.065	2
2002	286	0	357	1844.755	-305.04	D	1.744	20.92	22.664	8.34	3.1	1.541	0.051	0.038	0.018	0.002	0.094	3
2002	261	0	357	1844.755	-305.04	D	1.69	20.92	22.61	8.08	3.4	1.514	0.029	0.037	0.018	0.002	0.09	4
2002	291	0	364	1864.565	-300.448	D	1.37	20.92	22.29	6.55	3.1	1.153	0.082	0.037	0.015	0.002	0.081	5
2002	187	0	388	1843.4	-302.509	D	1.32	20.92	22.24	6.31	3.4	1.273	0.004	0.011	0.005	0.001	0.027	6
2002	362	0	388	1843.4	-302.509	D	1.242	20.92	22.162	5.94	3.1	0.618	0.509	0.027	0.014	0.002	0.072	7
2002	363	0	402	1859.851	-296.805	D	1.235	20.92	22.155	5.9	3.1	0.791	0.331	0.021	0.015	0.002	0.075	8
2002	287	0	357	1844.755	-305.04	D	1.206	20.92	22.126	5.76	3.1	1.104	0.031	0.018	0.009	0.001	0.044	9
2002	13	0	364	1864.565	-300.448	D	1.117	20.92	22.037	5.34	2.9	0.64	0.359	0.032	0.013	0.002	0.069	10
2002	186	0	388	1843.4	-302.509	D	1.037	20.92	21.957	4.96	3.4	1.006	0.001	0.007	0.004	0	0.019	11
2002	197	0	402	1859.851	-296.805	D	1.03	20.92	21.951	4.93	3.4	0.949	0.005	0.018	0.009	0.001	0.048	12
2002	267	0	388	1843.4	-302.509	D	0.882	20.92	21.802	4.22	3.4	0.826	0.009	0.013	0.005	0.001	0.028	13
2002	305	0	398	1856.394	-298.556	D	0.877	20.92	21.797	4.19	3.1	0.621	0.139	0.029	0.014	0.001	0.073	14
2002	181	0	402	1859.851	-296.805	D	0.867	20.92	21.787	4.15	3.2	0.802	0.003	0.016	0.007	0.001	0.038	15
2002	306	0	402	1859.851	-296.805	D	0.853	20.92	21.773	4.08	2.8	0.508	0.22	0.035	0.014	0.002	0.073	16
2002	40	0	388	1843.4	-302.509	D	0.734	20.92	21.654	3.51	2.7	0.51	0.13	0.023	0.012	0.001	0.059	17
2002	319	0	388	1843.4	-302.509	D	0.733	20.92	21.653	3.5	2.8	0.526	0.101	0.025	0.013	0.002	0.067	18
2002	168	0	388	1843.4	-302.509	D	0.704	20.92	21.624	3.36	3.2	0.565	0.016	0.032	0.014	0.002	0.074	19
2002	342	0	388	1843.4	-302.509	D	0.619	20.92	21.539	2.96	3.1	0.4	0.176	0.001	0.005	0.001	0.027	20
2002	325	0	388	1843.4	-302.509	D	0.606	20.92	21.526	2.89	2.8	0.476	0.041	0.021	0.011	0.001	0.055	21
2002	124	0	388	1843.4	-302.509	D	0.576	20.92	21.496	2.75	2.9	0.525	0.003	0.011	0.006	0	0.03	22

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
8.55	7.38	1.17
8.29	7.38	0.91
8.18	7.38	0.80
8.16	7.38	0.78
8.02	7.38	0.63
7.99	7.38	0.61
7.96	7.38	0.58
7.95	7.38	0.57
7.94	7.38	0.56
7.90	7.38	0.52
7.87	7.38	0.48
7.86	7.38	0.48
7.79	7.38	0.41
7.79	7.38	0.41
7.78	7.38	0.40
7.73	7.38	0.34
7.73	7.38	0.34
7.71	7.38	0.33
7.67	7.38	0.29
7.67	7.38	0.29
7.65	7.38	0.27

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

12

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

0.13

6. Enter desired NO₂/NOx ratio (default is 0)

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Source	BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	Rank	New	dv(total)	dv(bkg)	Δdv
2002	246	0	388	1843.4	-302.509	D	2.079	23.67	25.768	8.86	85	1.723	0.121	0.049	0.03	0.004	0.152	0	1	9.47	8.62	0.85
2002	304	0	388	1843.4	-302.509	D	1.545	23.28	24.840	6.69	82	1.139	0.31	0.018	0.013	0.001	0.065	0	2	9.10	8.45	0.65
2002	286	0	357	1844.755	-305.04	D	1.350	23.28	24.646	5.85	82	1.165	0.042	0.029	0.018	0.002	0.094	0	3	9.02	8.45	0.57
2002	261	0	357	1844.755	-305.04	D	1.348	23.67	25.031	5.75	85	1.185	0.025	0.029	0.018	0.002	0.09	0	4	9.18	8.62	0.56
2002	291	0	364	1864.565	-300.448	D	1.064	23.28	24.357	4.61	82	0.871	0.067	0.029	0.015	0.002	0.081	0	5	8.90	8.45	0.45
2002	187	0	388	1843.4	-302.509	D	1.040	23.67	24.720	4.43	85	0.995	0.003	0.009	0.005	0.001	0.027	0	6	9.05	8.62	0.43
2002	362	0	388	1843.4	-302.509	D	0.991	23.28	24.281	4.29	82	0.466	0.416	0.021	0.014	0.002	0.072	0	7	8.87	8.45	0.42
2002	363	0	402	1859.851	-296.805	D	0.975	23.28	24.265	4.22	82	0.596	0.27	0.016	0.015	0.002	0.075	0	8	8.86	8.45	0.41
2002	287	0	357	1844.755	-305.04	D	0.927	23.28	24.218	4.02	82	0.833	0.025	0.014	0.009	0.001	0.044	0	9	8.85	8.45	0.39
2002	13	0	364	1864.565	-300.448	D	0.880	23.08	23.966	3.85	80	0.48	0.292	0.025	0.013	0.002	0.069	0	10	8.74	8.36	0.38
2002	186	0	388	1843.4	-302.509	D	0.815	23.67	24.493	3.47	85	0.786	8E-04	0.005	0.004	0	0.019	0	12	8.96	8.62	0.34
2002	197	0	402	1859.851	-296.805	D	0.817	23.67	24.495	3.48	85	0.741	0.004	0.014	0.009	0.001	0.048	0	11	8.96	8.62	0.34
2002	267	0	388	1843.4	-302.509	D	0.696	23.67	24.374	2.97	85	0.645	0.008	0.01	0.005	0.001	0.028	0	15	8.91	8.62	0.29
2002	305	0	398	1856.394	-298.556	D	0.692	23.28	23.981	3.00	82	0.468	0.113	0.022	0.014	0.001	0.073	0	13	8.75	8.45	0.30
2002	181	0	402	1859.851	-296.805	D	0.669	23.40	24.079	2.88	83	0.608	0.002	0.012	0.007	0.001	0.038	0	16	8.79	8.50	0.28
2002	306	0	402	1859.851	-296.805	D	0.678	23.00	23.682	2.98	79	0.382	0.179	0.027	0.014	0.002	0.073	0	14	8.62	8.33	0.29
2002	40	0	388	1843.4	-302.509	D	0.582	22.92	23.507	2.56	78	0.385	0.106	0.018	0.012	0.001	0.059	0	17	8.55	8.29	0.25
2002	319	0	388	1843.4	-302.509	D	0.579	23.00	23.583	2.54	79	0.396	0.082	0.019	0.013	0.002	0.067	0	18	8.58	8.33	0.25
2002	168	0	388	1843.4	-302.509	D	0.556	23.40	23.965	2.40	83	0.428	0.013	0.025	0.014	0.002	0.074	0	19	8.74	8.50	0.24
2002	342	0	388	1843.4	-302.509	D	0.486	23.28	23.772	2.10	82	0.301	0.144	0.008	0.005	0.001	0.027	0	20	8.66	8.45	0.21
2002	325	0	388	1843.4	-302.509	D	0.475	23														

Ranked Daily Visibility Change for Swanquarter (Top 20 Days for 2003– New IMPROVE)

CALPOST Recalculation with New IMPROVE Algorithm

Version 2.
29 Sept. 2006

----- INPUT from CALPOST (based on old IMPROVE algorithm) -----

1. At cell A7, import "Ranked Daily Visibility Change" (bext) table, including column headings, from CALPOST (22 days, max)

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	BEXT(Model)	BEXT(BKG	BEXT(Total)	%CHANGE	F(RH)	bxSO4	bxNO3	bxOC	bxEC	bxPMC	bxPMF	Rank
2003	273	0	367	1854.086	-301.935 D	1.798	20.92	22.718	8.6	3.4	1.479	0.066	0.065	0.03	0.003	0.154	1
2003	173	0	364	1864.565	-300.448 D	1.393	20.92	22.313	6.66	3.2	1.318	0.013	0.015	0.008	0.001	0.038	2
2003	18	0	370	1856.287	-301.425 D	1.204	20.92	22.124	5.76	2.9	0.71	0.364	0.032	0.016	0.001	0.081	3
2003	347	0	388	1843.4	-302.509 D	1.009	20.92	21.929	4.82	3.1	0.706	0.2	0.026	0.012	0.002	0.063	4
2003	145	0	388	1843.4	-302.509 D	0.89	20.92	21.81	4.25	2.9	0.801	0.019	0.015	0.009	0	0.045	5
2003	83	0	357	1844.755	-305.04 D	0.884	20.92	21.804	4.23	2.6	0.667	0.092	0.03	0.016	0.002	0.079	6
2003	362	0	389	1844.133	-302.34 D	0.797	20.92	21.717	3.81	3.1	0.517	0.176	0.026	0.013	0.002	0.065	7
2003	68	0	388	1843.4	-302.509 D	0.789	20.92	21.709	3.77	2.6	0.456	0.247	0.021	0.01	0.001	0.053	8
2003	119	0	388	1843.4	-302.509 D	0.766	20.92	21.686	3.66	2.5	0.654	0.059	0.014	0.006	0.001	0.032	9
2003	32	0	388	1843.4	-302.509 D	0.738	20.92	21.658	3.53	2.9	0.611	0.09	0.008	0.005	0	0.024	10
2003	13	0	388	1843.4	-302.509 D	0.666	20.92	21.586	3.18	2.9	0.347	0.242	0.019	0.009	0.001	0.048	11
2003	279	0	398	1856.394	-298.556 D	0.65	20.92	21.57	3.11	3.1	0.539	0.039	0.016	0.009	0.001	0.046	12
2003	286	0	388	1843.4	-302.509 D	0.638	20.92	21.558	3.05	3.1	0.394	0.122	0.029	0.015	0.002	0.077	13
2003	183	0	401	1859.118	-296.976 D	0.616	20.92	21.536	2.94	3.4	0.591	0.002	0.007	0.002	0	0.013	14
2003	343	0	388	1843.4	-302.509 D	0.587	20.92	21.507	2.81	3.1	0.376	0.129	0.013	0.012	0.001	0.056	15
2003	360	0	357	1844.755	-305.04 D	0.586	20.92	21.506	2.8	3.1	0.328	0.15	0.027	0.013	0.002	0.067	16
2003	228	0	402	1859.851	-296.805 D	0.581	20.92	21.501	2.78	3.5	0.561	0.002	0.004	0.002	0	0.012	17
2003	105	0	388	1843.4	-302.509 D	0.535	20.92	21.455	2.56	2.5	0.455	0.044	0.009	0.004	0	0.022	18
2003	327	0	357	1844.755	-305.04 D	0.523	20.92	21.443	2.5	2.8	0.426	0.018	0.02	0.009	0.001	0.048	19
2003	25	0	380	1847.275	-302.563 D	0.524	20.92	21.444	2.5	2.9	0.246	0.214	0.015	0.008	0.001	0.039	20
2003	99	0	388	1843.4	-302.509 D	0.495	20.92	21.415	2.37	2.5	0.275	0.186	0.008	0.004	0	0.021	21
2003	238	0	397	1848.327	-300.425 D	0.454	20.92	21.374	2.17	3.5	0.418	0.011	0.006	0.003	0	0.015	22

5. Check calculated values below against CALPOST's "Ranked Daily Visibility"

(Optional)
Enter 24hr
NOx conc.

NOx(ppb)

dv(total)	dv(bkg)	Δdv
8.21	7.38	0.82
8.03	7.38	0.64
7.94	7.38	0.56
7.85	7.38	0.47
7.80	7.38	0.42
7.80	7.38	0.41
7.76	7.38	0.37
7.75	7.38	0.37
7.74	7.38	0.36
7.73	7.38	0.35
7.69	7.38	0.31
7.69	7.38	0.31
7.66	7.38	0.27
7.66	7.38	0.27
7.63	7.38	0.25
7.63	7.38	0.25
7.63	7.38	0.25
7.62	7.38	0.23
7.60	7.38	0.21

3. Enter value of site-specific Rayleigh scattering coefficient, from "Rayleigh & Sea Salt" worksheet

12
0.13

4. (Optional) Insert annual average sea salt concentration, from "Rayleigh & Sea Salt" worksheet. Leave blank if not used, i.e. default is 0.

6. Enter desired NO₂/NOx ratio (default is 0)

--

----- OUTPUT (based on new IMPROVE algorithm) -----

YEAR	DAY	HR	RECEPTOR	COORDINATES (km)	TYPE	Source BEXT(BKG	BEXT(Total)	%CHANGE	RH(%)	bsSO4	bsNO3	bsOC	bsEC	bsPMC	bsPMF	baNO2	Rank	New	dv(total)	dv(bkg)	Δdv
																		dv(total)	dv(bkg)	Δdv	
2003	273	0	367	1854.086	-301.935 D	1.450	23.67	25.135	6.19	85	1.157	0.056	0.05	0.03	0.003	0.154	0	1	9.22	8.62	0.60
2003	173	0	364	1864.565	-300.448 D	1.070	23.40	24.483	4.61	83	1.001	0.011	0.012	0.008	0.001	0.038	0	2	8.95	8.50	0.45
2003	18	0	370	1856.287	-301.425 D	0.951	23.08	24.038	4.16	80	0.532	0.296	0.025	0.016	0.001	0.081	0	3	8.77	8.36	0.41
2003	347	0	388	1843.4	-302.509 D	0.792	23.28	24.082	3.43	82	0.532	0.163	0.02	0.012	0.002	0.063	0	4	8.79	8.45	0.34
2003	145	0	388	1843.4	-302.509 D	0.682	23.08	23.767	2.98	80	0.601	0.015	0.012	0.009	0	0.045	0	6	8.66	8.36	0.29
2003	83	0	357	1844.755	-305.04 D	0.690	22.77	23.466	3.06	76	0.496	0.074	0.023	0.016	0.002	0.079	0	5	8.53	8.23	0.30
2003	362	0	389	1844.133	-302.34 D	0.633	23.28	23.922	2.74	82	0.389	0.144	0.02	0.013	0.002	0.065	0	7	8.72	8.45	0.27
2003	68	0	388	1843.4	-302.509 D	0.617	22.77	23.392	2.74	76	0.338	0.199	0.016	0.01	0.001	0.053	0	8	8.50	8.23	0.27
2003	119	0	388	1843.4	-302.509 D	0.592	22.71	23.304	2.63	75	0.494	0.048	0.011	0.006	0.001	0.032	0	9	8.46	8.20	0.26
2003	32	0	388	1843.4	-302.509 D	0.566	23.08	23.650	2.47	80	0.458	0.073	0.006	0.005	0	0.024	0	10	8.61	8.36	0.24
2003	13	0	388	1843.4	-302.509 D	0.529	23.08	23.612	2.31	80	0.26	0.197	0.015	0.009	0.001	0.048	0	11	8.59	8.36	0.23
2003	279	0	398	1856.394	-298.556 D	0.506	23.28	23.794	2.19	82	0.406	0.032	0.012	0.009	0.001	0.046	0	13	8.67	8.45	0.22
2003	286	0	388	1843.4	-302.509 D	0.513	23.28	23.800	2.22	82	0.297	0.1	0.022	0.015	0.002	0.077	0	12	8.67	8.45	0.22
2003	183	0	401	1859.118	-296.976 D	0.483	23.67	24.158	2.06	85	0.461	0.002	0.005	0.002	0	0.013	0	14	8.82	8.62	0.20
2003	343	0	388	1843.4	-302.509 D	0.467	23.28	23.754	2.02	82	0.283	0.105	0.01	0.012	0.001	0.056	0	16	8.65	8.45	0.20
2003	360	0	357	1844.755	-305.04 D	0.472	23.28	23.760	2.05	82	0.247	0.122	0.021	0.013	0.002	0.067	0	15	8.65	8.45	0.20
2003	228	0	402	1859.851	-296.805 D	0.465	23.84	24.312	1.97	86	0.446	0.002	0.003	0.002	0	0.012	0	17	8.88	8.69	0.19
2003	105	0	388	1843.4	-302.509 D	0.412	22.71	23.123	1.83	75	0.343	0.036	0.007	0.004	0	0.022	0	18	8.38	8.20	0.18
2003	327	0	357	1844.755	-305.04 D	0.409	23.00	23.411	1.80	79	0.32	0.015	0.015	0.009	0.001	0.048	0	20	8.51	8.33	0.18
2003	25	0	380	1847.275	-302.563 D	0.417	23.08	23.499	1.82	80	0.184	0.174	0.012	0.008	0.001	0.039	0	19	8.54	8.36	0.18
2003	99	0	388	1843.4	-302.509 D	0.390	22.71	23.100	1.73	75	0.207	0.152	0.006	0.004	0	0.021	0	21	8.37	8.20	0.17
2003	238	0	397	1848.327	-300.425 D	0.364	23.84	24.211	1.54	86	0.332	0.009	0.005	0.003	0	0.015	0	22	8.		

Ranked Daily Visibility Change for James River Face (Top 20 Days for Each Year – Existing IMPROVE)

YEAR	DAY	HR	REC	DV(Total)	DV(BKG)	DELTA DV	F(RH)	%_SO4	% of Modeled Extinction by Species					Ranking
									%_NO3	%_OC	%_EC	%_PMC	%_PMF	
2001	102	0	3	7.974	7.4	0.574	2.4	80.89	14.46	1.21	0.56	0.03	2.84	1
2001	141	0	2	7.939	7.4	0.538	3.0	91.02	4.67	1.09	0.52	0.03	2.67	2
2001	343	0	4	7.884	7.4	0.484	3.2	73.20	21.66	1.25	0.63	0.05	3.20	3
2001	247	0	40	7.793	7.4	0.392	3.6	90.12	3.21	1.64	0.82	0.06	4.15	4
2001	329	0	1	7.766	7.4	0.366	2.8	67.63	25.95	1.73	0.76	0.07	3.87	5
2001	305	0	1	7.753	7.4	0.353	3.2	78.41	13.19	2.32	0.96	0.08	5.03	6
2001	178	0	3	7.733	7.4	0.332	3.3	90.16	4.37	1.44	0.64	0.06	3.33	7
2001	138	0	17	7.725	7.4	0.325	3.0	68.05	28.75	0.82	0.38	0.02	1.97	8
2001	205	0	47	7.702	7.4	0.302	3.4	94.37	0.69	1.25	0.60	0.05	3.05	9
2001	103	0	40	7.617	7.4	0.217	2.4	82.18	13.10	1.21	0.57	0.02	2.92	10
2001	348	0	3	7.586	7.4	0.186	3.2	75.69	21.65	0.65	0.33	0.01	1.67	11
2001	215	0	2	7.563	7.4	0.163	3.7	89.23	7.58	0.83	0.38	0.03	1.95	12
2001	142	0	2	7.549	7.4	0.149	3.0	74.06	21.64	1.07	0.52	0.03	2.68	13
2001	253	0	47	7.537	7.4	0.137	3.6	93.72	1.29	1.16	0.63	0.03	3.17	14
2001	129	0	40	7.506	7.4	0.106	3.0	78.99	14.11	1.71	0.84	0.03	4.31	15
2001	252	0	52	7.49	7.4	0.090	3.6	92.85	4.03	0.79	0.38	0.02	1.94	16
2001	251	0	11	7.488	7.4	0.087	3.6	95.63	0.78	0.89	0.44	0.03	2.23	17
2001	229	0	40	7.471	7.4	0.070	3.7	96.13	0.43	0.85	0.42	0.03	2.14	18
2001	216	0	11	7.466	7.4	0.066	3.7	94.31	2.93	0.70	0.33	0.02	1.71	19
2001	214	0	11	7.466	7.4	0.066	3.7	88.87	6.93	1.05	0.51	0.03	2.61	20
2002	42	0	29	7.8	7.4	0.351	2.6	50.35	37.72	3.03	1.46	0.06	7.37	1
2002	216	0	3	7.6	7.4	0.242	3.7	95.91	0.43	0.87	0.45	0.05	2.30	2
2002	204	0	11	7.6	7.4	0.196	3.4	96.17	0.67	0.76	0.39	0.02	1.99	3
2002	80	0	40	7.6	7.4	0.184	2.7	49.62	40.26	2.53	1.22	0.08	6.29	4
2002	239	0	47	7.6	7.4	0.163	3.7	95.22	0.47	0.96	0.56	0.02	2.76	5
2002	195	0	47	7.6	7.4	0.157	3.4	92.84	0.83	1.44	0.81	0.03	4.05	6
2002	86	0	11	7.6	7.4	0.155	2.7	62.62	31.45	1.41	0.73	0.04	3.75	7
2002	183	0	11	7.5	7.4	0.139	3.4	95.95	0.58	0.89	0.42	0.02	2.14	8
2002	284	0	1	7.5	7.4	0.122	3.2	83.89	12.03	1.03	0.49	0.05	2.51	9
2002	274	0	11	7.5	7.4	0.116	3.6	87.38	7.43	1.33	0.63	0.04	3.19	10
2002	184	0	11	7.5	7.4	0.106	3.4	96.91	0.40	0.67	0.33	0.01	1.67	11
2002	353	0	1	7.5	7.4	0.097	3.2	59.13	33.84	1.91	0.82	0.04	4.27	12
2002	208	0	3	7.5	7.4	0.097	3.4	90.08	8.96	0.25	0.11	0.01	0.59	13
2002	172	0	3	7.5	7.4	0.092	3.3	68.40	21.49	2.58	1.24	0.11	6.18	14
2002	151	0	40	7.5	7.4	0.090	3.0	89.04	3.05	1.86	1.00	0.04	5.02	15
2002	104	0	2	7.5	7.4	0.090	2.4	79.16	15.88	1.25	0.60	0.02	3.07	16
2002	41	0	11	7.5	7.4	0.086	2.6	61.06	25.86	3.22	1.62	0.06	8.17	17
2002	185	0	11	7.5	7.4	0.081	3.4	97.42	0.26	0.58	0.28	0.01	1.44	18
2002	62	0	11	7.5	7.4	0.081	2.7	57.95	34.33	1.87	0.94	0.06	4.84	19
2002	354	0	40	7.5	7.4	0.080	3.2	65.36	26.70	1.95	0.98	0.04	4.98	20
2003	71	0	11	7.851	7.4	0.450	2.7	53.57	36.57	2.45	1.19	0.08	6.13	1
2003	299	0	40	7.827	7.4	0.427	3.2	74.12	17.14	2.36	1.04	0.10	5.25	2
2003	345	0	3	7.807	7.4	0.407	3.2	61.42	31.08	1.41	1.05	0.05	4.99	3
2003	233	0	3	7.782	7.4	0.382	3.7	95.26	1.80	0.76	0.35	0.03	1.80	4
2003	323	0	1	7.757	7.4	0.357	2.8	74.39	20.07	1.38	0.67	0.04	3.45	5
2003	283	0	2	7.681	7.4	0.280	3.2	69.46	23.78	1.71	0.81	0.08	4.16	6
2003	170	0	11	7.624	7.4	0.224	3.3	83.78	13.45	0.79	0.32	0.01	1.65	7
2003	38	0	40	7.602	7.4	0.202	2.6	56.71	35.77	1.86	0.94	0.04	4.68	8
2003	266	0	47	7.568	7.4	0.167	3.6	68.25	19.68	3.01	1.47	0.11	7.48	9
2003	282	0	40	7.562	7.4	0.162	3.2	86.71	7.55	1.45	0.70	0.03	3.56	10
2003	64	0	11	7.535	7.4	0.135	2.7	48.43	40.05	2.75	1.44	0.03	7.29	11
2003	88	0	1	7.531	7.4	0.131	2.7	74.55	14.01	2.96	1.37	0.12	6.99	12
2003	4	0	1	7.531	7.4	0.130	2.8	56.96	35.52	1.88	0.92	0.05	4.68	13
2003	147	0	40	7.522	7.4	0.122	3.0	82.67	13.41	0.97	0.48	0.02	2.45	14
2003	144	0	2	7.511	7.4	0.111	3.0	62.52	37.04	0.11	0.05	0.01	0.27	15
2003	75	0	11	7.511	7.4	0.111	2.7	70.26	20.78	2.08	1.12	0.07	5.69	16
2003	234	0	47	7.507	7.4	0.106	3.7	92.96	4.48	0.60	0.32	0.01	1.63	17
2003	300	0	47	7.497	7.4	0.097	3.2	71.09	16.52	1.86	1.82	0.05	8.66	18
2003	169	0	1	7.492	7.4	0.092	3.3	82.72	15.31	0.62	0.21	0.01	1.13	19
2003	126	0	11	7.492	7.4	0.092	3.0	69.78	23.55	1.65	0.82	0.04	4.16	20

Ranked Daily Visibility Change for Shenandoah (Top 20 Days for Each Year – Existing IMPROVE)

YEAR	DAY	HR	REC	DV(Total)	DV(BKG)	DELTA DV	F(RH)	%_SO4	% of Modeled Extinction by Species				%_PMF	Ranking
									%_NO3	%_OC	%_EC	%_PMC		
2001	247	0	55	7.8	7.41	0.37	3.90	94.31	0.88	1.19	0.59	0.04	2.99	1
2001	329	0	343	7.8	7.41	0.36	3.00	70.03	22.26	1.87	0.95	0.05	4.84	2
2001	334	0	340	7.8	7.41	0.34	3.00	76.39	18.88	0.90	0.65	0.02	3.16	3
2001	343	0	53	7.7	7.41	0.33	3.40	79.28	16.71	0.98	0.50	0.02	2.52	4
2001	179	0	166	7.7	7.41	0.33	3.40	86.64	8.12	1.29	0.64	0.07	3.25	5
2001	138	0	55	7.7	7.41	0.33	3.10	78.96	17.76	0.81	0.40	0.02	2.05	6
2001	103	0	55	7.7	7.41	0.32	2.50	82.41	12.93	1.22	0.56	0.03	2.86	7
2001	205	0	53	7.7	7.41	0.31	3.50	93.38	1.69	1.23	0.60	0.06	3.05	8
2001	253	0	310	7.7	7.41	0.30	3.90	84.85	7.87	1.83	0.88	0.06	4.52	9
2001	36	0	336	7.7	7.41	0.27	2.80	66.87	22.40	2.16	1.44	0.04	7.09	10
2001	129	0	55	7.6	7.41	0.22	3.10	84.73	9.32	1.54	0.71	0.05	3.66	11
2001	153	0	336	7.6	7.41	0.18	3.40	85.29	7.70	1.51	0.92	0.05	4.53	12
2001	215	0	168	7.6	7.41	0.17	3.90	88.02	8.73	0.85	0.39	0.03	1.99	13
2001	214	0	60	7.6	7.41	0.16	3.90	91.94	3.06	1.28	0.60	0.05	3.06	14
2001	252	0	336	7.6	7.41	0.16	3.90	88.69	7.66	0.81	0.47	0.03	2.34	15
2001	142	0	219	7.6	7.41	0.16	3.10	80.78	16.42	0.69	0.34	0.01	1.76	16
2001	348	0	55	7.6	7.41	0.15	3.40	77.38	19.97	0.66	0.32	0.02	1.65	17
2001	263	0	343	7.6	7.41	0.15	3.90	94.89	0.83	0.98	0.54	0.05	2.71	18
2001	306	0	182	7.6	7.41	0.14	3.00	73.06	20.18	1.70	0.82	0.03	4.21	19
2001	146	0	349	7.6	7.41	0.14	3.10	78.53	7.30	3.41	1.74	0.10	8.93	20
2002	42	0	68	8.1	7.41	0.67	2.80	63.34	31.72	1.31	0.61	0.07	2.94	1
2002	263	0	310	7.8	7.41	0.42	3.90	90.44	2.72	1.73	0.83	0.06	4.23	2
2002	150	0	182	7.7	7.41	0.34	3.10	73.99	18.92	1.95	0.84	0.10	4.21	3
2002	151	0	182	7.7	7.41	0.33	3.10	81.81	10.86	1.89	0.88	0.08	4.48	4
2002	278	0	227	7.7	7.41	0.31	3.20	93.87	0.19	1.45	0.73	0.03	3.73	5
2002	171	0	227	7.7	7.41	0.30	3.40	84.88	10.21	1.22	0.61	0.05	3.03	6
2002	104	0	227	7.7	7.41	0.30	2.50	71.39	19.56	2.22	1.11	0.06	5.65	7
2002	326	0	336	7.7	7.41	0.27	3.00	71.62	22.75	1.21	0.74	0.03	3.66	8
2002	86	0	219	7.7	7.41	0.27	2.80	66.20	27.53	1.59	0.76	0.04	3.88	9
2002	195	0	103	7.7	7.41	0.25	3.50	92.01	3.32	1.21	0.56	0.03	2.87	10
2002	354	0	182	7.7	7.41	0.25	3.40	62.12	29.40	2.13	1.03	0.05	5.27	11
2002	62	0	336	7.7	7.41	0.24	2.80	50.38	37.49	2.51	1.59	0.11	7.91	12
2002	271	0	310	7.6	7.41	0.21	3.90	62.99	34.93	0.53	0.25	0.03	1.27	13
2002	204	0	55	7.6	7.41	0.19	3.50	96.21	0.49	0.78	0.41	0.02	2.08	14
2002	130	0	55	7.6	7.41	0.18	3.10	74.80	20.08	1.50	0.59	0.07	2.97	15
2002	73	0	182	7.6	7.41	0.15	2.80	78.44	17.35	1.08	0.50	0.03	2.60	16
2002	365	0	310	7.5	7.41	0.14	3.40	48.28	44.68	1.86	0.83	0.07	4.28	17
2002	152	0	55	7.5	7.41	0.13	3.10	80.92	12.94	1.43	0.78	0.03	3.90	18
2002	216	0	53	7.5	7.41	0.12	3.90	96.10	0.50	0.80	0.42	0.03	2.14	19
2002	275	0	182	7.5	7.41	0.12	3.20	77.08	18.23	1.15	0.58	0.03	2.94	20
2003	258	0	310	8.8	7.41	1.41	3.90	89.62	6.00	1.08	0.53	0.05	2.72	1
2003	328	0	148	8.4	7.41	1.02	3.00	77.92	15.86	1.68	0.73	0.06	3.77	2
2003	345	0	103	8.2	7.41	0.76	3.40	45.60	48.17	2.02	0.63	0.11	3.47	3
2003	299	0	53	7.9	7.41	0.54	3.20	76.46	16.44	2.22	0.74	0.11	4.03	4
2003	344	0	336	7.8	7.41	0.36	3.40	63.46	30.98	1.37	0.68	0.04	3.48	5
2003	71	0	53	7.8	7.41	0.34	2.80	64.43	27.82	2.05	0.92	0.04	4.74	6
2003	136	0	336	7.7	7.41	0.26	3.10	86.92	7.45	1.48	0.66	0.06	3.43	7
2003	234	0	182	7.7	7.41	0.25	3.90	95.91	1.79	0.58	0.28	0.02	1.43	8
2003	281	0	182	7.7	7.41	0.25	3.20	88.49	7.38	1.06	0.49	0.05	2.53	9
2003	38	0	53	7.7	7.41	0.25	2.80	56.51	38.44	1.62	0.52	0.04	2.87	10
2003	61	0	336	7.6	7.41	0.22	2.80	75.78	19.80	1.06	0.55	0.03	2.78	11
2003	170	0	55	7.6	7.41	0.21	3.40	92.76	4.99	0.66	0.25	0.01	1.33	12
2003	233	0	53	7.6	7.41	0.20	3.90	96.24	1.15	0.67	0.31	0.03	1.60	13
2003	300	0	182	7.6	7.41	0.19	3.20	76.01	16.83	1.71	0.89	0.05	4.50	14
2003	39	0	74	7.6	7.41	0.18	2.80	62.10	32.57	1.31	0.66	0.03	3.33	15
2003	266	0	55	7.6	7.41	0.16	3.90	80.87	12.18	1.79	0.82	0.10	4.24	16
2003	75	0	55	7.6	7.41	0.16	2.80	80.37	10.81	2.30	1.06	0.07	5.38	17
2003	329	0	349	7.6	7.41	0.15	3.00	57.53	32.12	2.39	1.31	0.07	6.58	18
2003	64	0	182	7.6	7.41	0.14	2.80	64.68	27.33	1.96	0.99	0.05	4.99	19
2003	323	0	53	7.6	7.41	0.14	3.00	68.39	24.11	1.83	0.92	0.06	4.69	20

Ranked Daily Visibility Change for Swanquarter (Top 20 Days for Each Year – Existing IMPROVE)

YEAR	DAY	HR	REC	DV(Total)	DV(BKG)	DELTA DV	F(RH)	%_SO4	% of Modeled Extinction by Species				%_PMF	Ranking
									%_NO3	%_OC	%_EC	%_PMC		
2001	191	0	401	8.46	7.38	1.08	3.40	94.82	0.35	1.16	0.59	0.05	3.02	1
2001	197	0	364	8.29	7.38	0.91	3.40	93.09	0.59	1.62	0.74	0.10	3.86	2
2001	360	0	402	7.97	7.38	0.59	3.10	61.23	28.83	2.77	1.14	0.16	5.87	3
2001	131	0	373	7.82	7.38	0.43	2.90	91.77	0.56	1.76	0.98	0.05	4.88	4
2001	361	0	388	7.81	7.38	0.43	3.10	62.27	28.39	2.24	1.16	0.09	5.85	5
2001	262	0	402	7.80	7.38	0.42	3.40	88.60	6.64	1.17	0.58	0.06	2.95	6
2001	29	0	388	7.74	7.38	0.36	2.90	61.60	25.53	2.85	1.65	0.16	8.22	7
2001	78	0	388	7.72	7.38	0.34	2.60	61.40	20.29	4.45	2.24	0.15	11.47	8
2001	236	0	388	7.71	7.38	0.32	3.50	94.08	2.26	0.88	0.45	0.05	2.29	9
2001	169	0	388	7.70	7.38	0.32	3.20	84.08	1.74	3.68	1.70	0.18	8.61	10
2001	17	0	377	7.70	7.38	0.32	2.90	71.99	18.68	2.28	1.13	0.13	5.79	11
2001	304	0	388	7.69	7.38	0.31	3.10	71.88	18.66	2.43	1.12	0.14	5.78	12
2001	18	0	351	7.68	7.38	0.30	2.90	64.67	27.48	1.93	0.95	0.12	4.85	13
2001	337	0	398	7.68	7.38	0.29	3.10	78.46	10.99	2.56	1.29	0.17	6.53	14
2001	270	0	397	7.68	7.38	0.29	3.40	80.84	7.01	3.28	1.40	0.19	7.28	15
2001	261	0	388	7.66	7.38	0.28	3.40	88.56	5.52	1.39	0.74	0.06	3.74	16
2001	256	0	388	7.66	7.38	0.28	3.40	72.88	9.82	4.57	2.04	0.26	10.43	17
2001	3	0	397	7.64	7.38	0.26	2.90	50.13	33.63	4.08	1.96	0.22	9.98	18
2001	192	0	357	7.64	7.38	0.26	3.40	93.65	2.50	0.90	0.49	0.03	2.44	19
2001	170	0	357	7.63	7.38	0.25	3.20	82.18	4.72	3.39	1.56	0.18	7.97	20
2002	246	0	388	8.55	7.38	1.17	3.40	84.85	5.51	2.44	1.15	0.15	5.88	1
2002	304	0	388	8.29	7.38	0.91	3.10	75.79	19.08	1.17	0.65	0.05	3.26	2
2002	286	0	357	8.18	7.38	0.80	3.10	88.35	2.95	2.16	1.05	0.12	5.37	3
2002	261	0	357	8.16	7.38	0.78	3.40	89.57	1.73	2.18	1.06	0.14	5.32	4
2002	291	0	364	8.02	7.38	0.63	3.10	84.14	5.96	2.69	1.12	0.15	5.93	5
2002	187	0	388	7.99	7.38	0.61	3.40	96.39	0.32	0.80	0.40	0.04	2.05	6
2002	362	0	388	7.96	7.38	0.58	3.10	49.73	40.96	2.20	1.16	0.13	5.82	7
2002	363	0	402	7.96	7.38	0.57	3.10	64.06	26.76	1.72	1.25	0.13	6.08	8
2002	287	0	357	7.94	7.38	0.56	3.10	91.55	2.53	1.46	0.72	0.07	3.67	9
2002	13	0	364	7.90	7.38	0.52	2.90	57.34	32.16	2.89	1.20	0.20	6.21	10
2002	186	0	388	7.87	7.38	0.48	3.40	97.01	0.11	0.71	0.35	0.03	1.79	11
2002	197	0	402	7.86	7.38	0.48	3.40	92.11	0.49	1.79	0.90	0.09	4.61	12
2002	267	0	388	7.79	7.38	0.41	3.40	93.62	1.03	1.51	0.60	0.07	3.17	13
2002	305	0	398	7.79	7.38	0.41	3.10	70.79	15.88	3.28	1.63	0.11	8.32	14
2002	181	0	402	7.79	7.38	0.41	3.20	92.53	0.29	1.80	0.86	0.13	4.40	15
2002	306	0	402	7.78	7.38	0.40	2.80	59.56	25.77	4.16	1.65	0.25	8.61	16
2002	40	0	388	7.73	7.38	0.35	2.70	69.51	17.70	3.08	1.57	0.17	7.97	17
2002	319	0	388	7.73	7.38	0.34	2.80	71.71	13.72	3.39	1.81	0.21	9.17	18
2002	168	0	388	7.71	7.38	0.33	3.20	80.35	2.23	4.58	2.03	0.29	10.52	19
2002	342	0	388	7.67	7.38	0.29	3.10	64.64	28.42	1.57	0.88	0.10	4.40	20
2003	273	0	367	8.21	7.38	0.83	3.40	82.25	3.70	3.61	1.67	0.19	8.59	1
2003	173	0	364	8.03	7.38	0.65	3.20	94.64	0.93	1.08	0.54	0.05	2.75	2
2003	18	0	370	7.94	7.38	0.56	2.90	58.97	30.27	2.63	1.32	0.12	6.69	3
2003	347	0	388	7.85	7.38	0.47	3.10	69.99	19.81	2.59	1.22	0.16	6.22	4
2003	145	0	388	7.80	7.38	0.42	2.90	90.08	2.18	1.66	1.01	0.05	5.01	5
2003	83	0	357	7.80	7.38	0.41	2.60	75.41	10.35	3.41	1.77	0.18	8.89	6
2003	362	0	389	7.76	7.38	0.37	3.10	64.82	22.06	3.24	1.59	0.21	8.09	7
2003	68	0	388	7.75	7.38	0.37	2.60	57.82	31.33	2.72	1.31	0.13	6.69	8
2003	119	0	388	7.74	7.38	0.36	2.50	85.42	7.71	1.79	0.79	0.11	4.19	9
2003	32	0	388	7.73	7.38	0.35	2.90	82.87	12.18	1.08	0.64	0.05	3.19	10
2003	13	0	388	7.69	7.38	0.31	2.90	52.17	36.29	2.81	1.41	0.15	7.17	11
2003	279	0	398	7.69	7.38	0.31	3.10	82.91	6.08	2.48	1.39	0.13	7.01	12
2003	286	0	388	7.68	7.38	0.30	3.10	61.71	19.09	4.55	2.40	0.25	12.01	13
2003	183	0	401	7.67	7.38	0.29	3.40	95.94	0.35	1.12	0.40	0.07	2.12	14
2003	343	0	388	7.66	7.38	0.28	3.10	64.12	21.94	2.26	1.99	0.13	9.56	15
2003	360	0	357	7.66	7.38	0.28	3.10	55.88	25.59	4.54	2.25	0.28	11.45	16
2003	228	0	402	7.66	7.38	0.27	3.50	96.54	0.36	0.67	0.40	0.04	1.99	17
2003	105	0	388	7.63	7.38	0.25	2.50	85.04	8.18	1.74	0.80	0.08	4.16	18
2003	327	0	357	7.63	7.38	0.25	2.80	81.59	3.45	3.81	1.74	0.14	9.27	19
2003	25	0	380	7.63	7.38	0.25	2.90	46.95	40.94	2.95	1.48	0.15	7.53	20

U.S. Locations

AK, Anchorage (907) 561-5700	MA, Sagamore Beach (508) 888-3900	SC, Columbia (803) 216-0003
AK, Fairbanks (907) 452-5700	MA, Westford (978) 589-3000	TX, Dallas (972) 509-2250
AL, Birmingham (205) 980-0054	MA, Woods Hole (508) 457-7900	TX, Houston (713) 520-9900
AL, Florence (256) 767-1210	MD, Columbia (410) 884-9280	VA, Chesapeake (757) 312-0063
CA, Alameda (510) 748-6700	ME, Portland (207) 773-9501	WA, Redmond (425) 881-7700
CA, Camarillo (805) 388-3775	MI, Detroit (269) 385-4245	WI, Milwaukee (262) 523-2040
CA, Orange (714) 973-9740	MN, Minneapolis (952) 924-0117	Headquarters MA, Westford (978) 589-3000
CA, Sacramento (916) 362-7100	NC, Charlotte (704) 529-1755	Worldwide Locations
CO, Ft. Collins (970) 493-8878	NC, Raleigh (919) 872-6600	Azerbaijan Belgium Bolivia Brazil Canada China France Germany Ireland Italy Japan Malaysia Philippines Thailand Turkey United Kingdom Venezuela
Ft. Collins Tox Lab (970) 416-0916	NH, Gilford (603) 524-8866	
CT, Stamford (203) 323-6620	NJ, Piscataway (732) 981-0200	
CT, Willington (860) 429-5323	NY, Albany (518) 453-6444	
FL, St. Petersburg (727) 577-5430	NY, Rochester (585) 381-2210	
FL, Tallahassee (850) 385-5006	NY, Syracuse (315) 432-0506	
GA, Norcross (770) 381-1836	NY, Syracuse Air Lab (315) 434-9834	
IL, Chicago (630) 836-1700	OH, Cincinnati (513) 772-7800	www.ensr.aecom.com
IL, Collinsville (618) 344-1545	PA, Langhorne (215) 757-4900	
LA, Baton Rouge (225) 298-1206	PA, Pittsburgh (412) 261-2910	
MA, Air Laboratory (978) 772-2345	RI, Providence (401) 274-5685	